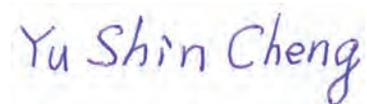


Foreword

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 2014 and 2015. 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 six fields, animal breeding and genetics, animal nutrition, animal physiology, processing of animal products, livestock management and forage crops. 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 annual report. This annual report is the summary results of the efforts completed in 2014 and 2015. 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.



Yu-Shin Cheng, Ph. D.
Director
Livestock Research Institute
Council of Agriculture

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Research and Development

Animal Breeding and Genetics

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

A performance of purebred Duroc, Yorkshire and Landrace boars with registered parents were tested at Hsinhua Station. The starting weight for the test set around 40 kg and off-tested on the weight of 110 kg or by 180 days of age during all test periods. The average daily gain (ADG), feed efficiency (FE) and back fat thickness (BF) of boars were recorded and evaluated as a contemporary group deviation to the mean of each breed for selection index calculation purposes. Selection index of 2005 version for Duroc was $SI = 100 + 120 ADG - 55 FE - 50 BF$ and for Landrace and Yorkshire was $SI = 100 + 140 ADG - 60 FE - 30 BF$. Off-tested boars with selection index 100 or above were then giving both pedigree registration (PR) and growth performance registration (GR). Each litter should have 2 or 4 littermate boars in test, therefore, percentage of litters having 0, 2 or 4 littermate boars with GR could be designated as growth trait uniformity. In those of GR Duroc boars, percentage of litter with 3 or 4 littermates

were 7.7% of year 2010 born and 15.6% of year 2013 born. In Landrace, there were 3.7% of year 2010 born and 8.8% of year 2013 born. In Yorkshire, there were 3.2% of year 2010 born and 10.7% of year 2013 born. Swine breeder farms accepted the essential key to improve stock performance by focusing on littermate uniformity. In year 2010 born boars, there were 50.2%, 58.8% and 44.7% of growth trait uniformity in Duroc, Landrace and Yorkshire, respectively. In year 2013 born boars, there were 60.4%, 61.0% and 52.8% of growth trait uniformity in Duroc, Landrace and Yorkshire, respectively. Based upon results, an increase of littermate boars or whole litter for the test would be served as a guideline for variation reduction of selected lines within breed in each breeding farm.

(M. C. Wu, Y. Y. Lai, N. T. Yen, T. Y. Kuo, C. H. Chen, M. L. Chen, H. L. Tsai, I. H. Hwang, H. R. Lin, H. L. Wang, M. S. Shueh, C. T. Lin, C. H. Lin, P. M. Chen and C. S. Wang)

The difference of total sperm count on collection season and breed in the semen samples from semen proved at nine month age of boar

This study traced 1,119 semen samples proved at nine month age of Landrace (N = 233), Yorkshire (N = 88) and Duroc (N = 798) boars from the members of Formosan Farmers



Boar semen collection

Association for Swine Improvement during 2011 to 2014. Each sample was measures for semen volume and concentration of sperm (COS). Total sperm count (TSC) was converted by semen volumes and concentration of sperm. No significant difference was found between hot season (Apr.-Sep.) and cool season (Oct.-Mar.) on semen volume and concentration and TSC of boar semen in Landrace, Yorkshire and Duroc. The average TSC of Landrace, Yorkshire and Duroc boars in hot season and cool season were 72.3 ± 26.4 and 73.6 ± 22.1 , 72.0 ± 18.9 and 67.4 ± 23.0 , and 67.0 ± 20.1 and 68.9 ± 20.5 billion sperms/ml, respectively. There were significantly different among of months of

TSC and COS in Landrace boars ($P < 0.05$) and Duroc boars ($P < 0.001$) and COS in Yorkshire boars ($P < 0.05$). The averages of TSC in Duroc boars were more than 71.5 billion sperms from Feb. to May and higher than Jul. to Dec. The averages of COS in Duroc boars were more than 0.402 billion sperms from Feb. to May. and higher than Jul. to Dec. Although comparison of those traits between hot season and cool

season was not significantly different in the three pig breeds. However, our results showed TSC of each month in Duroc boars based on the physiology of sperm formation process is still affected by the cool season and the hot season.

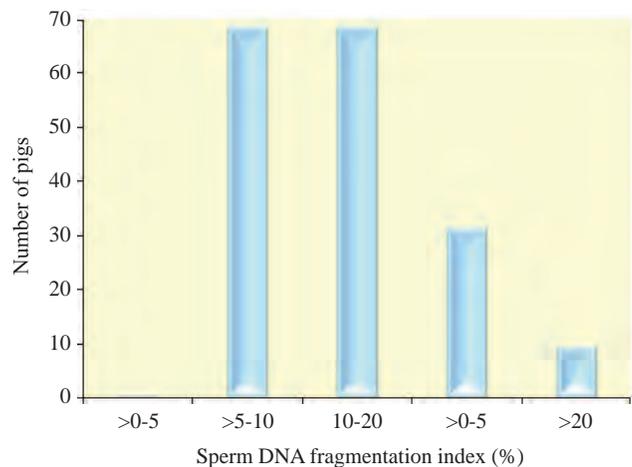
(Y. Y. Lai, T. Y. Kuo, H. C. Hsu, N. T. Yen, M. C. Wu, Y. C. Chen, S. Y. Lee, H. R. Tsai, H. F. Lee, T. M. Su, J. F. Liou, C. W. Liao, I. H. Hwang, K. C. Liu, P. M. Chen and C. S. Wang)

Fragmentation of sperm DNA in livestock

High standards of semen quality in livestock exploited for animal industry are of economic relevance due to its association with fertility and offspring results. The purpose of this study was to establish and investigate the sperm DNA fragmentation index (DFI) which could be considered normal in livestock such as boar, duck, geese and chicken. Ejaculates of 180 boar, 58 white Muscovy ducks, 30 white Roman geese and 277 Native Chicken were analysed and its DFI values were calculated by Flow cytometry. The results showed that DFI \leq 5% among species were 38.9%, 55.2%, 20% and 42.2%; DFI $>$ 10% were 17.8%, 20.7%, 26.7% and 19.9% and DFI $>$ 20% were 5.6%, 3.4%, 3.3% and 19.5%. An incidence of ejaculates with a DFI higher than 20% has been observed in all species suggest that adding sperm DNA fragmentation as a new parameter to the routine assessment of every ejaculate may be beneficial to the field and the sperm DFI values could be

an useful reference in extrusion of breeding animals.

(T. Y. Kuo, N.T. Yen, Y. C. Chen, S. Y. Lee, K. C. Liu, Y. Y. Lai and M. C. Wu)



Distribution of boar sperm DNA fragmentation index (DFI)

Cytometric measurement of sperm mitochondrial integrity in high feed efficiency boar

The objective of this study was 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 (FE) young boar and try to apply the elite young boar for the reproduction of breeding stock and the production of meat pig. A total of 114 finished test boars from 3 breeds (Duroc, Landrace and Yorkshire) in class Mar. 2014 and Apr. 2014 of the Pig Performance Testing Station of National Animal Industry Foundation were used in 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 each semen to assess the semen productive ability of young boar. The results showed that the sperm concentration and mitochondrial integrity of the young boars from better FE (56 boars with FE 1.89- 2.03) and from inferior FE (58 boars with FE 2.04-2.14) were 312 ± 130 ($10^6/\text{ml}$), 63.9 ± 17.3 (%) and 385 ± 142 ($10^6/\text{ml}$), 74.0 ± 13.1 (%), respectively. These measurements were significantly different ($P < 0.05$) between the two groups of young boars. In summary, these data indicated that young boars with better FE have decreased

sperm concentration and mitochondrial integrity. Wu, S. R. Wang and H. L. Lin)
(T. W. Kuo, T. Y. Kuo, Y. C. Chen, Y. Y. Lai, M. C.

The influence of semen concentration and individual on sperm viability after frozen-thaw in pigs

The influence of semen concentration and individual differences on the frozen-thaw sperm viability in pigs were determined in this study. The semen samples for evaluation were collected from the boars in Changhua Animal Propagation Station. Semen samples from 6 Duroc boars were mixed and adjusted to the concentrations of 13.1, 10.0, 7.8, 6.4 and 5.6×10^8 sperms/mL and then frozen into liquid nitrogen. After thawing, the sperm viability was determined by using fluorescence-based assay. The results showed that the frozen sperm at 6.4×10^8 sperms/mL exhibited the best viability after thawing of $43.3 \pm 9.0\%$ ($P < 0.05$). In addition, each semen sample collected from 7 Landrace and 17 Duroc boars were individually prepared as high (10.0×10^8 sperms/mL) and low (6.4

$\times 10^8$ sperms/mL) concentrations and then subjected to frozen. The result showed that the sperm average motility of the low concentration group after thaw (36.3%) was higher than that of the high concentration groups (25.8%). The boars with a sperm motility which is lower than 30% after frozen-thaw was 41.7% (10/24) in the high concentration groups and 25.0% (6/24) in the low concentration groups, respectively. However, it seems that the semen frozen-thaw protocols used in this study prefer to the sperm prepared at low concentration. Also, the detrimental effect from the individual difference of boars resulting to lower sperm viability after frozen-thaw was 25%.

(C. M. Wang, Y. H. Chen, Y. C. Chang, P. C. Nien, C. L. Hu and L. R. Chen)

Evaluating genetic diversity of LRI Duroc pigs by microsatellite markers

A total of 15 microsatellite markers, 13 markers recommended by FAO and 2 markers (OPN and KS148) related to the litter performance of Duroc, were used to evaluate the genetic diversity of 48 LRI Duroc pigs. The results indicated that only one marker showed no polymorphism and the other 14 markers showed polymorphisms. Based on the polymorphism features, 9 markers with high polymorphism information contents (PICs), 5 markers with moderate PICs and the other one with low PIC have been identified. The values of total

allele number, observed heterozygosity (H_o), expected heterozygosity (H_e) and polymorphism information content ranged from 1-12, 0-0.787, 0-0.875 and 0-0.752, respectively. The average values of allele number, H_o , H_e and PIC were 4.700, 0.566, 0.537 and 0.508, respectively. Overall, the LRI Duroc pig population has high genetic diversity, but the maintenance of genetic diversity of this pig population should be concerned.

(C. H. Chen, J. C. Chen, C. H. Wang, Y. S. Cheng, M. C. Wu and R. B. Liaw)

Sequence variation analysis of mitochondrial DNA D-loop region of breeding pigs

The aim of this study was to investigate the sequence variation of mitochondrial DNA D-loop region and to discover the difference within three breeds of breeding pigs with a selection index no less than 110. A total of 190 mtDNA samples from 64 heads of Duroc pigs, 63 heads of Landrace pigs and 63 heads of Yorkshire pigs were tested. The PCR products were amplified with mtDNA D-loop region specific primers and were purified by a

purification kit. After DNA sequencing and multiple alignment of all sequences, 26 variation sites were found in 557-bp DNA segment. Most of the variation type was T/C pattern (17 points), followed by A/G pattern (7 points), A/T pattern (1 point) and C deletion (1 point). Among three breeds of pigs, Yorkshire, Duroc and Landrace possessed 25, 19 and 13 variation sites, respectively. Based on the phylogenetic analysis, more than two breeds of pigs were

found on the same cluster. Therefore, it deserves further study to find possible causes.

(*R. B. Liaw, J. C. Chen, W. C. Chen, Y. S. Wang and M. C. Wu*)

Evaluation on reproductive performance of Taiwan Duroc boar

In order to evaluate the reproductive performance of the Taiwan Duroc boars at various generations, the Taiwan Duroc boars of generation R2 to R5 were mated with sows of Landrace (L) from swine breeding farm of Livestock Research Institute (LRI; $n = 12$) and pig farms ($n = 6$), Taoyuan black pig (T; $n = 2$) and sows of Landrace \times Yorkshire (LY; $n = 6$), Taoyuan ♀ \times Meishan ♂ (T \times M; $n = 2$), Taoyuan ♀ \times Large black pig ♂ (T \times M; $n = 1$) and Meishan ♀ \times Large black pig ♂ (M \times B; $n = 1$), respectively. The sows were further divided into exotic and black pigs for evaluating the reproductive performance of the Taiwan Duroc boars. The results showed that litter size at birth and piglet born alive in the LRI breeding farm and pig farm were 11.33 ± 3.06 and 12.00 ± 1.73 and 10.00 ± 2.65 and 10.33 ± 0.58 when mated the Taiwan Duroc boars of R2 with sows of L and LY. The litter size at birth and piglet born alive in the LRI breeding farm and pig farm

were, respectively, 9.00 ± 0.00 and 8.67 ± 1.53 and 9.00 ± 0.00 and 8.33 ± 1.53 when mated the Taiwan Duroc boars of R3 with sows of L and LY. The litter size at birth and piglet born alive in pig farms were 11.33 ± 3.06 and 9.00 ± 4.24 and 11.33 ± 3.06 and 8.00 ± 5.66 when mated the Taiwan Duroc boars of R4 and R5 with sows of L and LY, respectively. Moreover, the litter size at birth and piglet born alive were 7.00 ± 1.73 and 8.67 ± 4.04 and 7.00 ± 1.73 and 8.33 ± 4.16 when mated the Taiwan Duroc boars of R3 and R4 with sows of black pig, respectively. From these results reveals the Taiwan Duroc boars of R2 and R4 had better reproductive performance than those of other generations. Continually to collect records is required for accurate evaluation of reproductive performance in the Taiwan Duroc boars.

(*C. H. Chen, N. T. Yen, W. P. Fan, W. T. Wang and M. C. Wu*)

Evaluation on carcass traits of the crossbred offspring produced by mating boars of LRI Duroc with various black sows

This study was carried out under industry-academic cooperation and its purpose was to evaluate crossbred offspring (KR or BR) with the best combination in carcass traits following mating boars of LRI Duroc (R) with sows of KHAPS black pig (K) or hybrid black pig (B). Here, total of 48 offspring were sacrificed to collect carcass traits in KR (13 barrows and 11 gilts) and BR (13 barrows and 11 gilts). The carcass traits of barrows and gilts were calculated separately in both hybrids. The carcass length, muscle color score, marbling score and pork tenderloin either in barrows or gilts of BR were better than those of KR ($P < 0.05$). In that, the carcass length, muscle color score, marbling score and pork tenderloin were 103.31 ± 3.04 cm, 5.62 ± 0.51 , 8.77 ± 1.92 , 0.59 ± 0.07 in barrows and 104.82 ± 2.27 cm, 5.36 ± 0.50 , 7.73 ± 2.16 , 0.58 ± 0.06 in gilts of BR; but 99.62 ± 2.75 cm, 5.08 ± 0.64 , 6.15 ± 1.86 , 0.51 ± 0.07 in barrows and 100.82 ± 3.06 cm,

4.64 ± 0.50 , 5.18 ± 0.98 , 0.51 ± 0.06 in gilts of KR. The slaughter rate of barrows were also advantage in BR which were $87.98 \pm 0.54\%$ in BR and $87.47 \pm 0.68\%$ in KR. The skeletal rate in gilts of KR was lower than those of BR ($P < 0.05$). Moreover, there was no any difference in the traits such as market age, live weight, carcass weight, backfat thickness, abdominal fat thickness, loin eye area, pairs of ribs, lean percentage and fat percentage between BR and KR. We found that the offspring BR had better carcass performance such as carcass length and muscular color score which were accomplished by the breeding method used in this study.

(*C. H. Chen, Y. S. Cheng, N. T. Yen, W. S. Chen, C. H. Wang and M. C. Wu*)

Comparison on carcass traits in Taiwan Duroc and other pig breeds

High carcass yield and meat quality and the ability to grow quickly were characteristics of Duroc. The breeding goal was to develop a new breed with Duroc characteristics, prolific and high-quality meat genes. The carcass traits among Duroc and other breeds of barrow and gilt were compared in this study. Three pig breeds were sacrificed for collecting the carcass traits which includes the Taiwan Duroc from the swine breeding farm (10 barrows and 9 gilts) and pig farms (6 barrows and 6 gilts), LR pig (L♀ × R♂) from the swine breeding farm (16 barrows and 9 gilts) and pure Duroc from pig farms (8 barrows and 4 gilts). The results

showed that average of fat percentage was 8 to 10% among these three breeds. The highest percentage of lean was 54.16% and 53.03% in barrows of R4 and gilts of LR, respectively. The lowest backfat thickness was 1.63 and 1.33 cm in barrows of R5 and gilts of Duroc, respectively. The longest loin eye area was 58.40 and 68.87 cm² in barrows of Duroc and gilts of R5, respectively. Moreover, the longest carcass length was 105.0 cm either in barrows or gilts of LR, followed by barrows of R4 which carcass length was 102.4 cm.

(C. H. Chen, C. H. Yang, C. J. Li, C. T. Hsiao, W. H. Chang and M. C. Wu)

Comparison on the fatty acid composition of *Longissimus dorsi* between the Taiwan Duroc and Duroc

The purpose of this study was to investigate the difference on fatty acid composition of *Longissimus dorsi* between the Taiwan Duroc and Duroc. Taiwan Duroc of R4 from swine breeding farm (n = 13), LR market pig (n = 12), Taiwan Duroc of R5 housed off-site and Duroc (n = 12) were sacrificed to analyze the physical and chemical characteristics of *Longissimus dorsi* when body weight reached 110 to 120 kg. The results showed that the pork had higher content of unsaturated fatty acid (USFA; 55.56-61.12%) than those of saturated fatty acid (SFA; 38.91-43.46%). Of the USFA, approximately 45.31 to 49.56% was monounsaturated fatty acid (MUFA) and 7.20 to 15.81% was polyunsaturated fatty

acid (PUFA). The results also showed that the USFA content was higher than SFA in *Longissimus dorsi*. Among USFA, the oleic acid (C18:1) was the highest USFA followed by linoleic acid (C18:2) and among SFA, the palmitic acid (C16:0) was the highest SFA and stearic acid (C18:0) was second. Moreover, following comparison of fatty acid composition, the Taiwan Duroc of R5 had the highest USFA and PUFA in *Longissimus dorsi*, whereas the Duroc had the highest SFA and MUFA. These results reveal that the Taiwan Duroc pork is a better source of meat, but Duroc pork had more stability during meat processing.

(C. H. Chen, N. T. Yen, M. C. Wu and W. S. Chen)

Effects of crossbreeding on the carcass characteristics and meat quality of KHAPS black pig and Duroc crossbreds

This study was conducted to observe the effects of crossbreeding on the carcass traits and meat quality of K pig (Meishan♀ × Duroc♂, 50% Duroc), DK pig (KHAPS black pigs♀ × Duroc♂, 75% Duroc) and DKD pig (DK♀ × Duroc♂, 87.5% Duroc). A total of 36 pigs comprising 12 (6 barrows and 6 gilts) for each crossbreed was used in the present study. Animals were reared in the same housing condition with same feed diet for six months prior to slaughter. After an overnight chilling, the carcasses were graded and samples of *Musculus Longissimus dorsi* were obtained for

meat quality analysis. The average daily gain of DKD was higher (P < 0.05) than those of K and DK. The slaughter rate, loin eye area and lean percentage of DKD were higher (P < 0.05) than those of K and DK. Fat percentage of K was higher (P < 0.05) than that of DKD. In addition, the slaughter rate, loin eye area and lean percentage of DKD pigs were the best among the three crossbreeds.

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

Development of micropig genetic resources

During the two years, the individuals of G1 generation (registration litter numbers are #0478 and #0533) have reached 2-year-old age and there are four litters in G2 generation, #1621 (2 females), #1625 (3 males and 2 females), #1694(1 male and 4 females) and #1697 (2 males and 1 female) and six litter in G3 generation, #1721 (2 males and 2 female), #1768 (3 females), #1781 (3 females), #1800 (1

male), #1826 (5 males) and #1836 (1 male and 4 females). The body weight at birth, six weeks and five months of age and the morphological measurements such as body length, body height and rump width at the five months of age were collected. The working meeting was held to review and discuss the breeding progress each year.

(L. C. Chen, M. H. Huang and H. P. Chu)



G2 micropigs



G3 generation

Conservation and utilization of indigenous Minipig's genetic resource

The facilities, managements and animal care programs of the institution earned full accreditation (AAALAC, international) which helps the management of Lanyu pig germplasm. The Lanyu gilts were distributed into five groups according to their own the genetic distance from genetic marker analysis in autosomes and different haplotypes of mitochondrial DNA not only to make the mating system operate regularly but also to maintain the genetic diversity of Lanyu pig conservation herd. In 2004, the molecular biological techniques were used to find out the detailed genetic relationship among the individuals and applied for population management of conservation herd to maintain genetic diversity. In 2015, the analysis on genetic distance among all the individuals of breeding herd of Lanyu pig was carried out by the same method to evaluate the breeding system. The results showed the expected heterozygosity was 0.55 and the

observed heterozygosity was 0.49, Except SW951, all the other 11 genetic markers were not deviated from the Hardy-Weinberg equilibrium significantly that indicate the breeding system is running appropriately. Meanwhile, the genetic diversity of cryopreservation will be enhanced by selecting more boars with distinctive genetic variation for semen collection and the frozen semen have been preserved from 4 minipig breeds.

(L. C. Chen, M. H. Huang, C. C. Chang and H. P. Chu)



Training boar for semen collection

Farming county of Ten Tons Cow and their maternal milk yield in upward four generations

Ten Tons Cow is designated as milk yield of 305-2X-ME greater than 10,000 kg for hot and humid environment in Taiwan. For breeding scheme of dairy cattle, selection on milk yield and quality associated with

reproductive performance is essential to the hot and humid weather. A total of 5,742 Ten Tons Cow was recorded from year 2001 to October of 2014. Among of them, there are 900 head with maternal pedigree in upward three

or more generation. Farming county with at least 10 head were Changhua with 458 head in 28 farms, Tainan with 234 head in 23 farms, Chiayi with 71 head in 19 farms, Kaohsiung with 42 head in 9 farms, Pingtung with 31 head in 15 farms, Yunlin with 23 head in 8 farms and Taoyuan with 17 head in 3 farms, in which were 97.3% (876/900) of 900 Ten Tons Cow. Selection of 366 cows with measured milk yield in 2014 is used for comparison on milk yield between cows either with upward four or three generations. Cows of 224 head with upward four generation had 10,736 kg of milk yield and their maternal upward from one to four generation had 9,604, 9,423, 9,065 and 9,009 kg of milk yield, respectively. Cows of

142 head with upward only three generation had 10,718 kg of milk yield and their maternal upward from one to three generation had 9,616, 9,239 and 8,961 kg of milk yield, respectively. Cows of 27 head having maternal milk yield in upward four generations, they had 10,846 kg of milk yield and their maternal upward from one to four generation had 10,080, 9,738, 9,265 and 8,934 kg of milk yield, respectively. Based upon maternal milk yield and pedigree to select heifer in dairy herds, it indicated that milk performance of dairy cows in Taiwan could be improved in generations.

(M. C. Wu, H. L. Lin, Y. Y. Lai, C. L. Chang, S. J. Lee, J. Y. Chen, E. M. Shy, I. H. Hwang, Q. Q. Fang, J. L. Ding, W. L. Chou and C. S. Wang)

The pilot study on genotype screening of brachyspina syndrome on dairy cattle herds in Taiwan

Brachyspina syndrome (BS) is inherited autosomal recessively in Holstein cattle, which would result in miscarriage or stillbirth for dairy cows and thus cause unpredictable economic losses to dairy farmers. The purpose of this study is to reveal bovine brachyspina syndrome carriers frequency in dairy cattle population. A total of 441 samples were genotyped, which were 409 blood samples from four dairy farms and 32 frozen bovine semen samples. Thirty-five blood samples and one frozen semen were identified as BS carriers and the others were normal. The frequencies of carriers for blood

samples and frozen semen were 8.56 and 3.13%, respectively. Because of high frequency in BS carrier genotype, it implies that the dairy farmers have potential losses due to BS. Therefore, the BS genotypes of bovine frozen semen needs to be under surveillance and ensure no BS carrier calves into dairy cattle population in Taiwan. Thus, it is possible to eliminate gradually the genetic deficiency in the future.

(R. B. Liaw, J. C. Chen, W. C. Chen, S. S. Tsay, C. S. Huang, J. Y. Chen, T. F. Shiao, K. H. Lee, Y. C. Chou, M. C. Wu and H. L. Chang)

Induction of successive follicular waves by exogenous hormone to improve fertility of Holstein cows during the hot season

Dairy lactating cows exposure to high temperature and humidity environment, usually respond with lower their conception rate in summer. This study was to evaluate whether induction 3 successive follicular waves with GnRH and PGF2 α might improve Holstein dairy cow fertility during hot season. Lactating dairy cows were housed in a free-stall facilities barn with a spray and fan cooling system. Cows (n = 60; 38 primiparous and 33 multiparous) at 40 to 50 days in milk were stratified by parity and randomly assigned to control or treatment groups during the months of April through July. The treated cows were hormonally treated to induce 3 consecutive 9-d follicular

waves, with synthetic GnRH analog (100 μ g of gonadorelin) administration followed by PGF2 α analog (500 μ g of cloprostenol) injection 7 d later. Estrus was detected within 6 d from the third PGF2 α administration. The control cows were inseminated following manifestation of spontaneous estrus. Artificial insemination (AI) service was inseminated 1 dose for the two groups after heat detection. Pregnancy was diagnosed by rectal palpation 45 to 55 d after AI. The results were shown that conception rates of primiparous treated group and control group were 45.0% (9/20) and 33.3% (6/18), respectively. Conception rates of multiparous treated group and control group were 22.2%

(4/18) and 20.0% (3/15), respectively. Parity on pregnancies per AI with primiparous cows (39.5%; 15/38) having greater pregnancies per AI than multiparous cows (21.2%; 7/33). The results indicated that conception rates of primiparous cows increased fertility compared to the multiparous cows in the hot season. Moreover, primiparous cows are responsive to the GnRH and PGF2 α administration in improving their reproduction efficiency.

(D. W. Yang, T. F. Shiao, J. S. Hwang, S. S. Tsay, H. W. Ou and C. H. Hsieh)



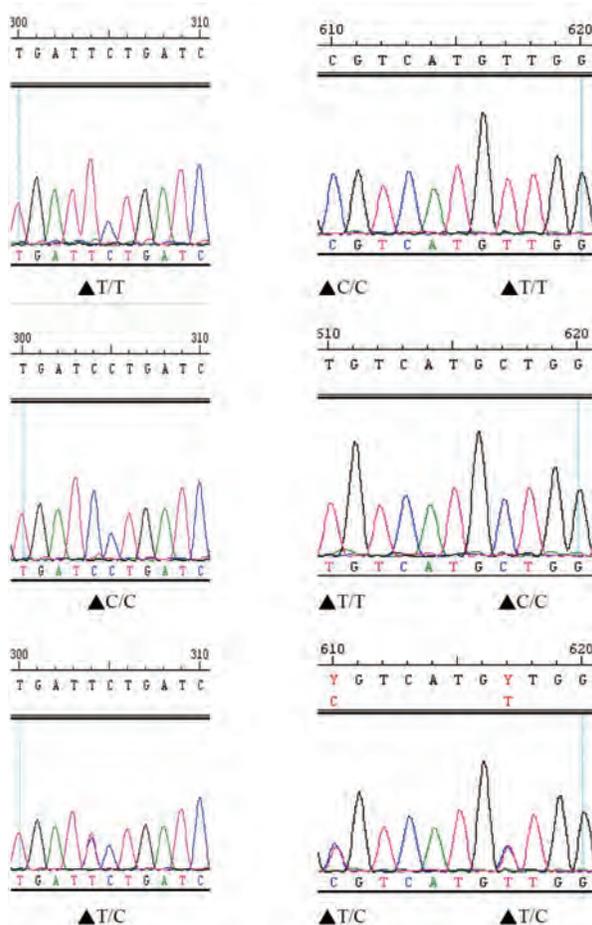
Induction of successive follicular waves by exogenous hormone

The study of FSHR, LHR and Era genes of water buffalo

The study was to investigate the polymorphisms of the follicle stimulating hormone receptor (FSHR), luteinizing hormone receptor (LHR) and estrogen receptor- α (Era) genes of water buffalo. The results showed that the polymorphisms of FSHR exon 10 gene were located at 304 bp, 610 bp and 617 bp (all C > T transition). The effects of FSHR 304 C > T polymorphism on calving

interval of cows and birth weight of calves were not significant difference. However, the cow with 304 C/C gene type had the highest sex ratio of male calves. There were no SNP found in LHR exon 11 (827 bp) and Era promoter exon c gene (248 bp) in the test water buffalo.

(P. H. Chuang and A. K. Su)



C > T transition located at 304,610 and 617 bp of FSHR exon 10

Assessment of introduction of Taiwan Yellow Cattle and dispersion conserved Peng-Hu from Taiwan

This study was imported Taiwan Yellow Cattles form Heng-Chun Branch, Livestock Research Institute, Council of Agriculture, Executive Yuan to Peng-Hu archipelago (also called Pescadores Islands), for the purpose of cattle conservation and utilization and the possibility of Taiwan Yellow Cattles in Peng-Hu county. 1 male and 4 female (2 female pregnancy) were introduced in 2014 and their offspring (1 male and 1 female) were calved in 2015. Ten female (5 female pregnancy) were introduced in 2015 and their offspring (3 male and 2 female) were calved in 2015. We complied the pedigree records of inducing cattle, districted pastoral area and feeding system, vaccine the

original cattle and quarantined isolation the importing cattle, educated and trained the field operators, etc. After observation, the calves had a great capacity to adapt to the new environment. We will keep importing frozen semen for artificial insemination. The sea around Peng-Hu is a natural barrier to defend diseases. The Taiwan Yellow Cattles line has been conserved in Peng-Hu as a Gene bank. We will keep importing frozen semen and promoting the cattles to local farmers to improve the species and meat quality of cattles in Peng-Hu. It will advantage sustainable development and make this industry more competitive.

(M. C. Lu and S. J. Huang)



The Taiwan Yellow Cattles



The adaption of calve

Genetic diversity maintenance and application of Taiwan Yellow Cattle and Taiwan Black Goat

The purposes of this study are preserving the typical Taiwan Yellow Cattle and Black Goat. Their genetic materials were maintained the biological diversity of Taiwan livestock gene pools and for future utilization in selection and breeding of anti-stress environment cattle or goat breeds. Furthermore, back-flow of conserved animals to private farms will contribute significantly to the risk-spreading of loss of the genetic resources and assist the beef and goat industries to found the featured brand of domestic beef and goat meat by introducing the yellow cattle beef and black goat meat to innovate their niche-market, about which can increase the value of these indigenous animals and their scopes for long term utilization. In 2014, new strain registration of Taiwan Black Goat was permitted by the COA in the

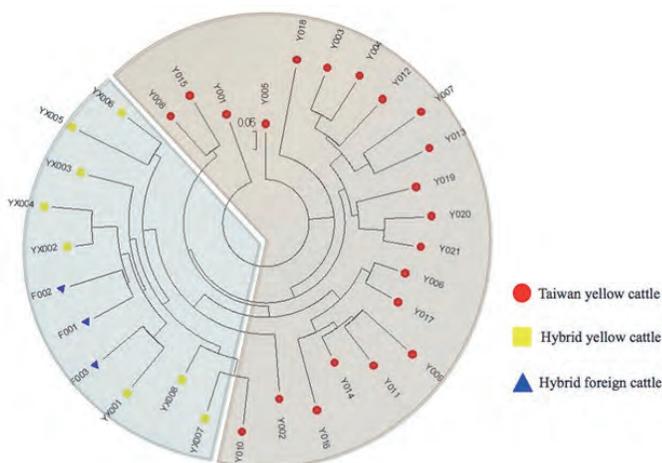
name of “Taiwan Black Goat, Hengchun line (HG)”. One hundred and twenty four TY and 48 HG were extended from 2014 to 2015. Till the end of 2015, the conservation population in Hengchun Branch were 211 and 86 for Taiwan Yellow Cattle (TY) and Taiwan Black Goat (HG), respectively. The accumulated number of spreaded conservation farms are 11 (2 official sites and 9 private sites) for TY and 8 (1 official site and 7 private sites) for the time being. Head on farms of 9 TY and 7 HG private conservation farms were 181 and 75, respectively. Totally, there are 18 Yellow cattle raising units and 455 (151 males, 304 females) heads on farms in Taiwan and Penghu area. The current cattle raising information is published on the official website of COA, with respect to the field investigation of TY. For

cryopreservation of semen cells, 566 doses of semen from 6 TY bulls and 410 doses of semen from 6 HG bucks were frozen for long term preservation. Blood samples from 91 TY and 34 HG were sent to Animal Genetic Center for DNA cryopreservation. With respect to the genetic diversity analysis, in 2014, the newly self-invented DNA kit by using 17 microsatellite markers can separate pure Taiwan Yellow Cattle and crossbred yellow cattle, which siring by exotic beef breed to two herding groups. By applying this DNA kit to beef consuming market, the marketing of TY beef brand can be assured through the identification test of TY and other crossbred beef with or without yellow

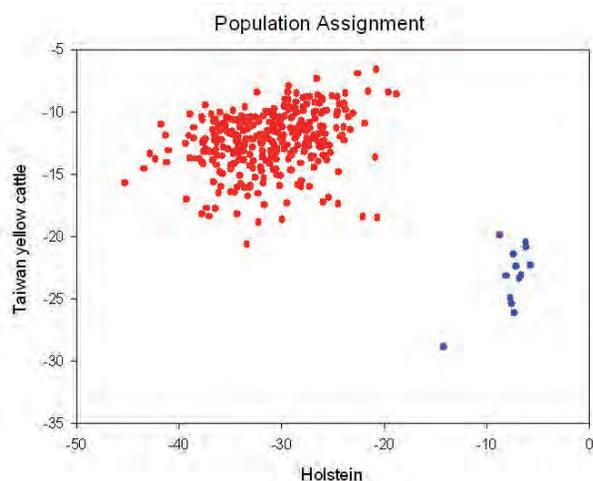
cattle blood. In 2015, 15 microsatellite markers were used to test the TY and Holstein (Hol) cattle individuals for genetic marker analysis. Maximum likelihood method was used for breed assignment test in 13 Hol and 343 TY and the accuracy was 100% correct. Results revealed that these 15 microsatellite markers could be applied for breed identification between Hol and TY. In Taiwan's beef consuming market, TY beef was false propagated by restaurants which usually replaced by other beef. By applying this technique, TY beef can also be assured through the identification test with dairy cattle, which occupied at least 85% of domestic beef market. (G. F. Li, P. A. Tu, K. F. Tseng and S. S. Yang)



Taiwan Yellow Cattle and Taiwan Black Goat risk-spreading conservation on private farms in Chiayi (left), Kaohsiung (middle) and Pingtung (right) county



Phylogenetic tree tested by the Neighbor-joining method (NJ) separated TY and crossbred Taiwan Yellow cattle into two herding groups



Result of breed assignment test used maximum likelihood method in Hol and TY

Genetic diversity analysis of white Taiwan Water Buffalo herd in LRI-COA by microsatellite markers

The genetic diversity of white water buffalo population was studied in Taiwan Water Buffalo conservation herd of Hualien Animal Propagation Station of LRI. A set of 12

microsatellite markers recommended for water buffalo in FAO's DADIS MoDAD programme were utilized to analyze all 9 animals to generate genotype data. Except CSSM045 and CSSM070,

all the microsatellites were polymorphic with average allelic number 2.7, ranged from 1 to 4 alleles per locus. There were 32 alleles detected in total. The observed heterozygosity of the population ranged from 0 to 0.778 and the average of observed heterozygosity was 0.389. The expected heterozygosity ranged from 0 to 0.699 and the average of expected heterozygosity was 0.483. The estimated polymorphic information content (PIC) ranged

from 0 to 0.611 and the average of PIC was 0.404. In 12 markers, five markers were highly informative with PIC more than 0.5 and two markers, CSSM045 and CSSM070, had only one allele detected. Therefore, geneticist should be aware of the genetic diversity of white water buffalo herd.

(D. Y. Lin, S. J. Tzeng, P. H. Chuang, Y. Y. Lai, A. K. Su and M. C. Wu)

Selection of heat-resistant goat breeds

Selection of heat-resistant dairy and meat goat breeds in Hengchun Branch, LRI has been going on for years. Frozen semen of French Alpine sires was used by artificial insemination to improve lactation performances of local Alpine herds. The new selected meat goat, which contained 87.5% Boer goat blood known as Kenting Goat, was registered on 5th, June, 2015. Milk yield and milk components were recorded monthly. The average daily milk yield, percentages of fat, protein, lactose, solid nonfat and total solid content were 2.89 ± 0.40 kg, $3.24 \pm 0.40\%$, $3.30 \pm 0.30\%$, $4.20 \pm 0.10\%$, $8.17 \pm 0.40\%$ and $11.21 \pm 0.90\%$, respectively. For Kenting Goat, the rate of kidding, single and twin births were 170% (34/20), 30.0% (6/20) and 70.0% (14/20), respectively. The percentage of kids with solid black of coat color was 73.5%. Average body weights of male and female kids at 3, 6 and 9 months of age were 3.0 ± 0.7 kg vs. 2.9 ± 0.4 kg, 18.4 ± 3.6 kg vs. 14.9 ± 1.4 kg, 35.0

± 2.8 kg vs. 27.2 ± 1.9 kg and 49.9 ± 3.8 kg vs. 39.6 ± 3.6 kg, respectively. Differences were not significant in growth performances and carcass characteristics between male and female groups. Microsatellite DNA analysis was performed on 120 heads of Kenting goat using 15 microsatellite markers. Results showed that the observed heterozygosity was 0.194 (McM0527) to 0.821 (HSC), with the average of 0.555. The number of expected heterozygosity was 0.282 (INRA023) to 0.814 (HSC), with an average of 0.635. The 15 microsatellite markers have medium ($0.25 < \text{PIC} < 0.5$) to high ($\text{PIC} \geq 0.50$) polymorphic information content (PIC). All markers were significantly deviated from Hardy-Weinburg equilibrium except OarFCB20, CSRD0247 and SPS113. The result indicated a mild level of inbreeding in Kenting goat population.

(S. S. Yang, R. H. Yeh, I. C. Chou, P. A. Tu, D. C. Wang and J. C. Huang)



Buck of Kenting goat



Doses of Kenting goat

Genotyping of mucopolysaccharidosis and genes in association with meat quality for Nubian goat

The aim of this study was to detect the genotypes of Mucopolysaccharidosis and genes in association with meat quality for Nubian goat. Totally, 103 genomic DNA samples were

collected from two goat farms located in eastern Taiwan and southern Taiwan for defining the genotype of (Mucopolysaccharidosis, G6S), (pituitary transcription factor, POU1F1) and

(Calpastatin, CAST) genes by PCR-RFLP or by PCR-SSCP method. Genotyping frequencies of each gene for Nubian goat were analyzed. The preliminary results, there were two G6S genotypes, normal type AA and heterozygous type AB. The frequency for AB type was 0.10 (1/103) and all 75 Nubian goats were normal from farm located in southern Taiwan. According to DQ826413 DNA sequence of NCBI, we designed a pair primer for POU1F1 gene to amplify Nubian DNA by PCR and got the 481 bp products, then digested with AluI restriction enzyme. The POU1F1 genotype frequencies of CC and CT were 0.79 and

0.21, respectively. And we used a pair primer designed by Zhou et al. (2007) for CAST gene to amplify Nubian DNA by PCR and got the 253 bp products, then genotyped by SSCP analysis. The SSCP analysis of CAST gene constituted three different genotypes, A, B and C. The CAST genotype frequencies of A, B and C were 0.77, 0.13 and 0.10, respectively. The results are potentially useful for Nubian goat farmer to breed G6S-AA type goat and to get good meat quality by gene selection in the future.

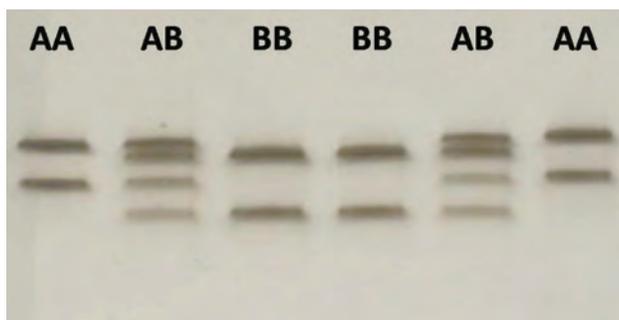
(N. T. Yen, J. C. Chen, P. Y. Chen, Y. Y. Lai, D. Y. Lin, S. Y. Wu, C. H. Chen, M. C. Wu, H. P. Chu and H. L. Chang)

Association of growth hormone gene polymorphisms with weight of velvet antler in Sambar deer

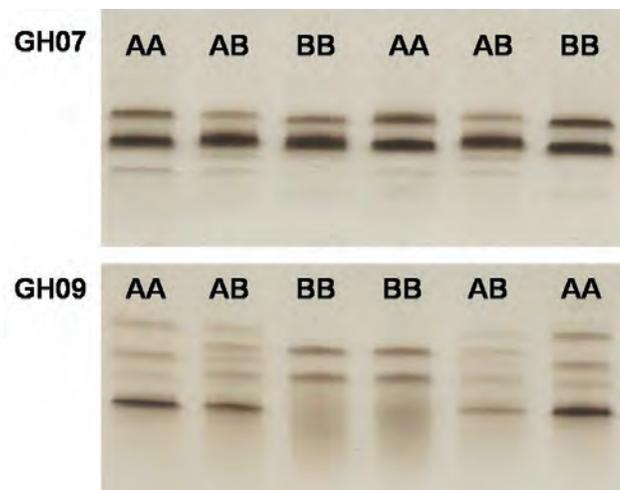
The objective of this study was to evaluate the association of GH gene polymorphisms with the weight of velvet antler in sambar deer. Genotyping was performed by single strand conformation polymorphism (SSCP) analysis. There were 3 primers were used for PCR for amplifying DNA fragments. The results showed that the PCR products exhibited polymorphisms and indicated the presence of two alleles, which were denoted as the GH-A and GH-B. Nine genotypes GH02-AA, GH02-AB, GH02-BB, GH07-AA, GH07-AB, GH07-BB, GH09-AA, GH09-AB and GH09-BB were

indicated. The result showed that GH07-AB group has significant highest weight of velvet antler ($P < 0.05$) and the GH07-AB group has a significantly lower weight of velvet antler ($P < 0.05$). GH genes may involve in the formation of velvet antler, but need increase the sample size to confirm the results.

(H. M. Liang, D. Y. Lin, S. Z. Kang, H. H. Lin, K. H. Hung and C. Y. Lin)



Non-denaturing polyacrylamide gel electrophoresis showing different SSCP variants in the GH02 gene



Non-denaturing polyacrylamide gel electrophoresis showing different SSCP variants in the GH07 gene and GH09 gene

The carcass characteristics and brisket constituent in homozygous genotypes of TLRI chicken

To identify a particular breed of chickens in many breeds of Taiwan native chickens, Livestock Research Institute applied in breeding

procedure and established the homozygous genotypes of Heat Shock Proteins (HSP-70) and Prolactin receptor (PRLR) in chickens which

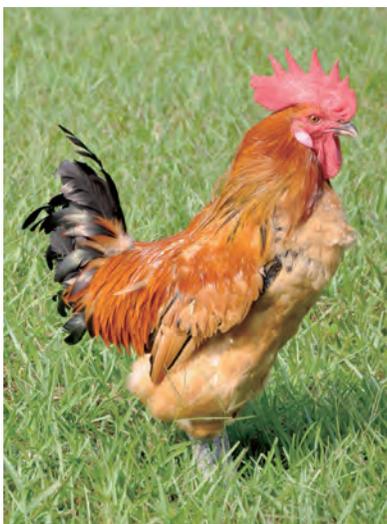
had heat resistant and early maturing characters. Three generations for inbreeding procedure, the homozygous genotype strains as LRI native chicken KT number 7, 9, 11 and 12 were obtained. Evaluation of growth performance on the homozygous genotype strains × red feather chicken showed that cross breeding might

improve the birth weight, 8 weeks weight and 16 week weight of germplasms. Cross breeding did not affect the dressing percentage, breast percentage and constituent of the breast muscle. (H. M. Liang, D. Y. Lin, S. Z. Kang, M. J. Wu and C. Y. Lin)

Genetic diversity analysis of high egg production line L7 native chicken in LRI-COA by microsatellite markers

LRI high egg production line L7 native chicken, which was selected for number of egg based on the inbreeding line L7 native chicken of Livestock Research Institute, Council of Agriculture LRI-COA for six generations. To assess the genetic variability of high egg production line L7 breeding population, we use a set of 24 microsatellite markers to analyze 80 candidate bred chickens from this flock.

Except MCW0216, all microsatellites were polymorphic. The average allelic number was 3.3, ranged from 1 to 7 per locus. The expected heterozygosity ranged from 0 to 0.737 and the average expected heterozygosity was 0.42 ± 0.19 (mean \pm SD). The observed heterozygosity of the population ranged from 0 to 0.850 and the average observed heterozygosity was 0.42 ± 0.23 . The estimated average polymorphic information content (PIC) was 0.37 ± 0.17 . In 24 markers, seven markers were highly informative with polymorphism information content ($\text{PIC} \geq 0.50$), eleven markers were reasonably informative ($0.5 > \text{PIC} \geq 0.25$) and the other six markers were slightly informative ($\text{PIC} < 0.25$). These results could be provided basic molecular information for the research on the germplasm characteristics of high egg production line L7 native chicken in LRI-COA.



Rooster of native chicken line L7 in LRI-COA



Hen of native chicken line L7 in LRI-COA

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

Association of heat shock protein 70 gene polymorphisms with acute thermal tolerance, growth and egg production traits of native chickens in Taiwan

This study aimed to examine the physiological responses-including triiodothyronine (T3) levels, enzymatic activity of creatine kinase (CK) and lactate dehydrogenase (LDH), respiratory rates and cloacal temperature to acute heat stress associated with different genotypes of the HSP70 gene and to evaluate the association of these polymorphisms with growth and egg production. Genotyping was performed by single-strand conformation polymorphism

analysis. The polymorphisms identified were A258A, A258G and G258G. Twenty 12-week old birds were randomly selected from each genotype and exposed to 40°C ambient temperature for 1 h. Blood samples were collected at 0 and 1 h following heat stress. Respiratory rate and cloacal temperature were measured following 0, 30 and 60 min of exposure. After 1 h, the A258A genotype exhibited lower levels of CK activity and

plasma T3. Neither respiratory rate nor cloacal temperature displayed a significant association with the genotypes. Body weight gain differed among the genotypes for males ($F = 3.268$, $P = 0.041$) and females ($F = 14.029$, $P < 0.001$) and the A258A genotype exhibited the greatest weight gain at 0-16 weeks of age for both genders. There were no significant differences among genotypes regarding egg weight at first egg or the number of eggs laid until 40 weeks of age. The A258A genotype displayed higher heat tolerance with no negative effects on growth performance and egg production.

(H. M. Liang, D. Y. Lin, Y. D. Hsuuw, T. P. Huang, H. L. Chang, C. Y. Lin, H. H. Wu and K. H. Hung)

Evaluation of pullorum disease elimination in high egg production selection breeding flocks of native chicken in LRI-COA

Pullorum disease, caused by *Salmonella pullorum*, is mainly spread by horizontal transmission or infected eggs. Acute outbreaks occur in farms quit often and the affected chicken become no symptomatic carriers and infects the chicks via eggs. Therefore, eliminating the pullorum disease remains an important issue in poultry industry. The purpose of this trial is to evaluate the feasibility of establishing a pullorum disease test free breeding flocks in high egg production lines of LRI native chicken. Blood samples, 1 to 2 mL, collected from wing veins about of 15 to 20 week-old candidate bred chickens in each generation and then assayed in rapid serum plate agglutination test. All the

positive birds will be eliminated. Positive rate of pullorum disease in G1, G2, G3, G4, G5, G6, G7 and G8 were 18.16% (219/1,206), 1.99% (12/602), 2.94% (28/951), 19.24% (152/790), 5.81% (41/706), 15.08% (162/1,074), 0% (0/557) and 0% (0/573), respectively. All of the candidate bred chickens were negative in serological diagnosis of pullorum disease. The result shows the selection method to eliminate candidate bred chickens with positive reaction of pullorum disease from breeding flocks could be useful to reduce the positive rate of pullorum disease in chicken flocks.

(D. Y. Lin, S. J. Tzeng, Y. F. LIN, J. C. Chen, Y. Y. Lai and M. C. Wu)

Improvement of egg production performance in native chicken line L11 of LRI-COA

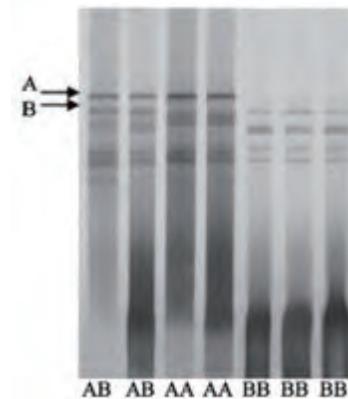


Rooster of native chicken line L11 in LRI-COA



Hen of native chicken line L11 in LRI-COA

In order to establish the platform for improving egg production performance in native chicken, high number of eggs hens were selected for breeding from inbreeding lines L11 of Livestock Research Institute. After six generations of selection for number of eggs production, there were significant differences of the age at first egg (AFE), body weight at first egg (BWAFE), body weight at 40 weeks (BW40), Egg weight at 40 weeks (EW40), number of eggs laid up to 40 weeks of age (EN40) were detected among the generations



Non-denaturing polyacrylamide gel electrophoresis showing different single strand conformation polymorphism (SSCP) variants in the HSP70 gene. AA (A258A), AB (A258G) and BB (G258G) genotypes were identified

($P < 0.001$). The average AFE, BWAFE, BW40, EW40 and EN40 of hens in G0 and G6 were 155 days and 134 days, 1,567 g and 1,788 g, 29.8 g and 30.6 g, 1,691 g and 2,012 g, 46.2 g and 47.9 g and 72.2 eggs and 98.4 eggs, respectively. The percentage of hens yield more than 100 eggs up to 40 weeks of age at G0 and G6 were

13.96% and 57.14%, respectively. Our result shows the platform of improving egg production performance could be used for native chicken breeding farms.

(*D. Y. Lin, Y. F. Lin, H. R. Tsai, Y. Y. Lai, H. L. Lin, S. L. Liu, Y. C. Chen and M. C. Wu*)

Improvement of egg production performance in Kaishing Guiding native chicken

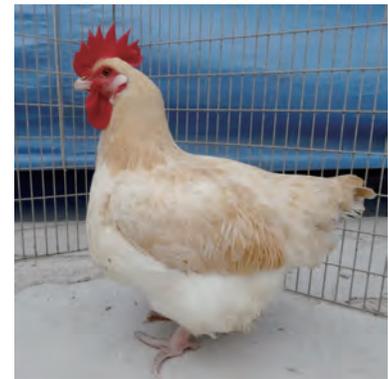
To improve the egg production performance of red feathered chickens in Kai Shing Trading Co., Ltd. and then to establish Kaishing Guiding native chicken line. Six rooster and 72 hens from original red feathered chicken flock were selected as selection flock. The selection standards of candidate breeders were in addition to PD negative, skin color score and body weight. And hens were selected with not only their own but also dam's egg production performance. Roosters were selected with their own sperm quality and their dam's egg production performance. To analyze egg production performance of those hens from six generations, there were significant differences in the age at first egg (AFE) and egg number up to 40 weeks of age (EN40) were detected among the generations ($P < 0.001$). The average of AFE of hens in G1, G2, G3, G4, G5 and G6 were 184 ± 20 days, 192 ± 26 days, 224 ± 23 days, 204 ± 18 days, 190 ± 14 days and 186 ± 22 days, respectively. And the mean of EN40 of

hens in G1, G2, G3, G4, G5 and G6 were 60.4 ± 23.0 eggs, 53.3 ± 22.6 eggs, 32.4 ± 17.0 eggs, 43.5 ± 15.2 eggs, 61.1 ± 13.8 eggs and 70.2 ± 15.2 eggs, respectively. After six generation selection, there were 9.8 eggs improvement in EN40 of hens. Our result shows breeders were selected with EN40 could improve egg production performance of native chicken.

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



Rooster of Kaishing Guiding native chicken



Hen of Kaishing Guiding native chicken

Study on carcass characteristics for roosters of high egg production native chicken line CM in LRI-COA



Rooster of native chicken line CM in LRI-COA



Hen of native chicken line CM in LRI-COA

LRI-COA high egg production line CM native chickens, which were selected on high egg production for six generation based on the F1 population crossed by cocks of inbreeding line L12 native chicken of Livestock Research Institute, Council of Agriculture (LRI-COA) and hens of commercial brown layer. To study the carcass characteristics of line CM, we use cocks with 2.0-2.2 kg body weight at 16 weeks of age as experiment animals. Cocks reached 2.3 kg were slaughter at 19 weeks and 21 weeks of age. Comparison of carcass characteristics of

the cocks at different weeks of age in this trail, there are no significantly different on not gutted carcass weight (NGCW), gutted carcass weight (GCW), dressing percentage (DP) and breast and thigh as percentage of carcass weight (BTP) of cocks in different ages and the NGCW, GCW, DP and BTP of cocks at 19 weeks and 21 weeks of age were 2240 ± 61 g and $2,224 \pm 98$ g, $1,934 \pm 53$ g and $1,936 \pm 95$ g, 78.99% and 80.21%

and 67.72% and 67.06%, respectively. However, on lean meat of breast and thigh as percentage of carcass weight (LBTP), there was significant different between 19 and 21 weeks of age (45.80% vs. 47.24%). Our result shows roosters rearing up to 2.3 kg over 21 weeks compared with 19 weeks got better LBTP.

(D. Y. Lin, Y. Y. Lai, Y. F. Lin and Y. C. Chen)

Investigation of exterior characteristics, PD and livability of commercial silky chicken

The experiment was to investigate the difference of exterior characteristics, pullorum disease (PD) and livability of silky chicken in different commercial farms. Three farms were investigated, one farm in Kaohsiung city and two farms in Yunlin county as farm A, B and C. A total of 204, 202 and 218 chicks were hatched respectively in LRI and were divided into three pens during 2012-2014. The chicks were tagged with wing number and weighed. Water and feeds were provided *ad libitum*. Exterior characteristics, PD and livability were investigated at 12 weeks of age. The results indicated that exterior characteristics during 2012-2014 were white silky feather and no beard. The other characteristics for walnut-like comb in farm A, B and C were $84.8 \pm 2.0\%$, $85.1 \pm 1.3\%$ and $71.9 \pm 26.8\%$, respectively.

Tassel-like head were $1.0 \pm 1.7\%$, $2.6 \pm 3.3\%$ and $4.3 \pm 7.4\%$, respectively. Blue year were $31.5 \pm 13.4\%$, $36.4 \pm 19.6\%$ and $30.8 \pm 22.0\%$, respectively. Five toes were $86.9 \pm 7.9\%$, $93.3 \pm 6.1\%$ and $95.9 \pm 1.4\%$, respectively. Hairy legs were $44.4 \pm 5.7\%$, $47.9 \pm 8.7\%$ and $40.2 \pm 16.3\%$, respectively. For average PD for three years, farm B was the highest at $1.3 \pm 1.1\%$; farm A $0.7 \pm 1.2\%$ and farm C was the lowest at $0.6 \pm 1.0\%$. For the livability during 0-12 weeks of age, farm B in 2012 was the best at 100%; farm B in 2014 was the worst at 74.6%. Average livability for three years during 0-12 weeks of age, farm A, B and C was $91.8 \pm 4.3\%$, $90.1 \pm 13.6\%$ and $92.0 \pm 8.1\%$, respectively.

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

Investigation of feed efficiency, maximum and minimum body weight of commercial silky chickens in different years and farms

The experiment was to investigate the feed efficiency, maximum and minimum body weight of commercial silky chicken in different years and farms. Three farms were investigated, one farm in Kaohsiung city and two farms in Yunlin county were investigated as farm A, B and C. Two hundred and sixty four, 270 and 299 chicks from farm A, B and C from 2011-2014 were hatched. The chicks were tagged with wing number and were divided into three groups. Water and feeds were provided *ad libitum* during 0-3 (CP 21.3%, ME 3,243 kcal/kg), 4-6 (CP 16.1%, ME 3,114 kcal/kg) and 7-12 (CP 15.6%, ME 2,843 kcal/kg) weeks of age. Body weight and feed intake were recorded at 8 weeks of age. Growth performance was compared

among the groups. The results indicated that the maximum body weights at 8 weeks of age, farm B in 2011 was the highest (1,816 g) and farm C in 2014 was the lowest (1,082 g). Average body weight for 4 years, farm B was the highest at $1,637 \pm 186$ g, then farm A $1,551 \pm 149$ g and farm C the lowest at $1,519 \pm 307$ g. Minimum body weights at 8 weeks of age, farm B in 2012 was the highest (901 g) and farm C in 2014 was the lowest (437 g). Average maximum body weight for 4 years, farm A was the highest at 795 ± 50 g, then farm B 751 ± 126 g and farm C the lowest at 628 ± 187 g. The feed efficiency during 0-8 weeks of age, farm B was the worst at 3.29 in 2014; farm C the best at 2.31 in 2012. Average feed efficiency for 2011-2014 was 2.38

± 0.03 , 2.43 ± 0.10 , 2.53 ± 0.09 and 3.15 ± 0.12 , respectively. Four years' average feed efficiency for farm A, B and C was 2.60 ± 0.34 , 2.67 ± 0.42

and 2.60 ± 0.34 , respectively.

(*C. M. Hung, H. L. Liu, M. Y. Tsai, Y. F. Lin, H. C. Huang, T. F. Chen, C. H. Hsieh and Y. S. Cheng*)

Comparison of fertility, hatchability and hatched rate of commercial silky chicken in different years and farms

The experiment was to investigate the difference of fertility, hatchability and hatched rate of commercial silky chicken in different years and farms. Three farms were investigated, one farm in Kaohsiung city and two farms in Yunlin county were investigated as farm A, B and C. Three hundred ninety one, 400 and 417 breeder eggs from farm A, B and C from 2011-2014 were incubated. Eggs were lighted for examination of fertilized eggs at 7th day. Eggs were hatched at 21st day. Fertility, hatchability and hatched rate (good chicks) were investigated. The results indicated that fertility of farm C in 2012 was the highest at 93.9% and farm C in 2013 was the lowest at

71.8%. Average fertility for 4 years, farm A was the highest at $85.8 \pm 7.4\%$, then farm B $84.8 \pm 3.2\%$ and farm C the lowest at $83.3 \pm 9.4\%$. Hatchability of farm C in 2012 was the highest at 88.9% and farm C in 2013 was the lowest at 62.7%. Average hatchability for 4 years, farm A was the highest at $78.1 \pm 6.7\%$, then farm C $76.7 \pm 11.6\%$ and farm B the lowest at $76.3 \pm 6.9\%$. Hatched rate of farm C in 2012 was the highest at 80.8% and farm A in 2014 was the lowest at 56.1%. Average hatched rate for 4 years, farm A to C was $67.5 \pm 9.5\%$, $67.5 \pm 5.0\%$ and $72.0 \pm 9.2\%$, respectively.

(*C. M. Hung, H. L. Liu, M. Y. Tsai, D. Y. Lin, Y. F. Lin, H. C. Huang, C. H. Hsieh and Y. S. Cheng*)

Determination of egg production performance of white chicks at the generation of selection

The experiment was to determine the egg production performance of LRI white silky chickens at the 8th generation of selection to provide the reference of breeding and egg production performance improvement. Three batches of chicks were hatched and tagged with wing number individually. Feed was provided ad libitum. Birds were caged 18 weeks of age. Age, egg weight and body weight at 1st egg, egg production, egg weight and body weight at 40 weeks of age were recorded. The hens of another batch was determined body weight, egg weight and egg production number at 72 weeks of age. Birds with good egg production

performance were selected as breeders for reproduction of next generation. A total of 235 and 47 silky hens had been accomplished 40-week's and 72-week's egg production test, respectively. The results showed that age, egg weight, body weight at 1st egg were 158 ± 14.8 days, 29.7 ± 6.5 g, $1,181 \pm 162$ g, 39.4 ± 3.3 g and 97 ± 23 pieces, respectively. Body weight, egg weight and egg number at 72 weeks of age were $1,515 \pm 180$ g, 43.7 ± 3.2 g and 237 ± 31 pieces, respectively.

(*H. L. Liu, Y. F. Lin, C. M. Hung, C. H. Hsieh and Y. S. Cheng*)

Fatty acid comparison of breast of white silky chickens at 20 weeks of age

The experiment was to determine the breast fatty acid composition of LRI white silky chickens at 20 weeks of age for the establishment of basic data. A total of 6 birds including 3 males and 3 females were scarified. Breast meats were determined for fatty acid compositions. The results indicated that saturated fatty acids comprised 33.7%. Monounsaturated fatty acids comprised 35.8%. Polyunsaturated fatty acids

comprised 30.5%. Saturated fatty acids include C14:0, C15:0, C16:0, C17:0, C18:0, C20:0. Monounsaturated fatty acids include C14:1, C16:1, C18:1, C20:1, C22:1. Polyunsaturated fatty acids include C18:2, C18:3, C20:2, C20:3, C20:4, C20:5, C22:6. Linoleic acid C18:2 was $17.5 \pm 1.00\%$; α -linolenic acid C18:3 was $0.50 \pm 0.17\%$. Those are essential fatty acids. Arachidic acid C20:4 (AA) was $6.57 \pm 3.27\%$;

Eicosapentaenoic acid C20:5 (EPA) was $0.32 \pm 0.13\%$ and Docosahexaenoic acid (DHA) was $4.67 \pm 2.75\%$. Those are related to growth, brain

development and vision, especially in infant. It can be nutritious resources.

(*H. L. Liu, Y. F. Lin and C. M. Hung*)

Inbreeding coefficient of LRI white and black silky chickens at the eight generation

The white (SW) and black (BW) silky chickens bred from the Livestock Research Institute were used as experiment birds. The chicks hatched with pedigree with tagged with wing number individually. Feeds were provided *ad libitum*. Birds were caged at 18 weeks of age. Egg production performance of each hen had been determined till 40 weeks of age. Fifteen males and 75 females of better egg production performance in each generation were selected. Birds were mated for next generation and avoided full sib and half sib. Inbreeding coefficient of each generation was analyzed using PROC INBREED of SAS statistical software. Collection of 8 generation from 2005-2014, there were 2,654 SW and 3,161 BW hatched chicks. A total of 115 males and 503 breeder in SW and 120 males and 534

females in BW were used for mating from 0 to 8th generation. The results indicated that the average inbreeding coefficient in SW of each generation were 0.002, 0.031, 0.059, 0.075, 0.093, 0.109 and 0.134, respectively. At the 8th generation, inbreeding coefficient of males was 0.132 ± 0.024 and females was 0.135 ± 0.024 . The results indicated that the average inbreeding coefficient in BW of each generation were 0.025, 0.030, 0.056, 0.062, 0.094, 0.111 and 0.139, respectively. At the 8th generation, inbreeding coefficient of males was 0.140 ± 0.022 and females was 0.138 ± 0.024 . It showed that inbreeding coefficient increased slowly after selection of 7 generation for egg production at 40 weeks of age and pedigree mating.

(*H. L. Liu, Y. F. Lin, C. M. Hung, C. H. Hsieh and Y. S. Cheng*)

Development of novel technology for semen conservation and transportation of breeding stocks in animal industry

This study aimed to develop the application model of cold-stored technique of Muscovy duck semen for mule duck production. Mixed Muscovy drake semen was divided into 4 groups: raw semen, raw semen added to saline, commercial extender and self-made extender, respectively. Semen of all groups were stored at 0°C for 2 or 8 hr then artificially inseminated to 12 Kaiya ducks, respectively. The fertility were 86.4, 87.3, 96.9 and 91.4% after 2 hr of storage. The fertility were 0, 0, 84.5 and 86.9% respectively after 8 hr of storage. The commercial and self-made extenders both showed good fertility. The mixed Muscovy drake semen were diluted with commercial or self-made extenders were in 1:1 ratio and stored at 4, 7 and 10°C for 24 hr. The fertility of semen

with commercial extender were 77.8, 75.0 and 70.0%, respectively. The fertility of semen diluted with self-made extender were 46.4, 30.3 and 8.8%, respectively. The commercial extender showed higher fertility than self-made extender did. As the results from this study indicated that diluted Muscovy semen with commercial or self-made extender maintained over 80% fertility after storage at 0°C for 8 hr, that means the semen from Muscovy breeder farm could be effectively delivered to Kaiya duck farm within 8 hr to spread good genetic resources widely and to reduce the disease risk of Kaiya duck farm when introducing Muscovy drake from other duck farms.

(*L. Y. Wei, H. C. Liu, C. H. Su, Y. Y. Chang, Y. A. Lin and J. F. Huang*)

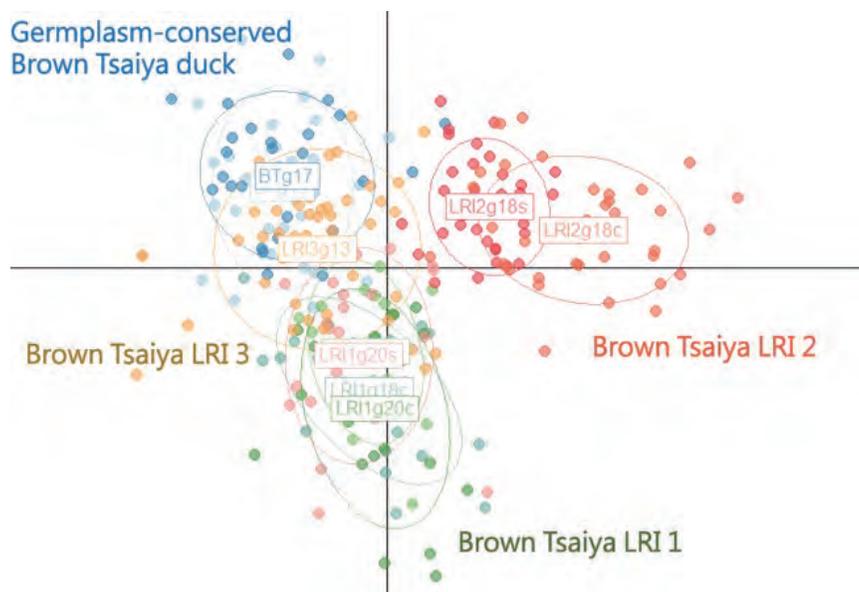
Comparison of genetic diversity between conserved populations and economic traits selection populations of ducks

Eleven microsatellite markers derived from Tsaiya duck were applied to the genetic

analysis for germplasm-conserved populations and selective populations of White Tsaiya

ducks and Brown Tsaiya ducks. In White Tsaiya ducks, the 15th generation of germplasm-conserved population (WTg15) showed lower genetic diversity than the 11th generation one (WTg11), with slight differentiation, which may be caused by one generation with not rotational mating program, between the two generations was observed. In the comparison between the selected (the 27th generation of Ilan White Tsaiya TLRI NO.1, L102g27) and conserved populations (WTg11 and WTg15), high F_{ST} values indicated a considerable degree of differentiation between the two homologous populations, supposed to be resulted from the long-term selection over 20 generations on the body size and white feather color after the isolation of conserved line; it may also lead to obviously lower genetic diversity in selected White Tsaiya ducks than other Tsaiya lines.

In Brown Tsaiya ducks, both of control and selected lines of Brown Tsaiya LRI 2 showed the highest differentiation and comparatively low genetic variations than the other Brown Tsaiya ducks, it might be resulted from the smaller population size. On the other hand, there was almost no differentiation between the two generations whether in germplasm-conserved Brown Tsaiya duck (the 15th and 17th generation) or in the control line of Brown Tsaiya LRI 1 (the 18th and 20th generation). It said that current mating strategies may be helpful to keep the genetic structure in these two lines. Therefore, it is suggested that the genetic monitoring should be carried out continuously for the conservation of the endemic duck breeds. (Y. Y. Chang, J. F. Huang, L. Y. Wei and H. C. Liu)



Result of PCA analysis indicated that only Brown Tsaiya LRI 2 was differentiated from the other Brown Tsaiya duck populations

Improving the quality of minimal disease Muscovy duck herd for biomedical purpose

The objective of this study was to set up a minimal disease Muscovy duck herd and establish the embryonic eggs and duckling supply system for researching, development and production of waterfowl vaccine. The minimal disease Muscovy duck herd (MD Muscovy) has been selected from L302G13 (white Muscovy duck LRI 1) and were raised in a high-biosecurity duck house. The antibody of

goose parvovirus (GPV), Muscovy parvovirus (MDPV) and duck hepatitis virus (DHV) was monitored when the ducks were 12, 24 and 40 weeks by serum neutralization (SN) and virus neutralization (VN). After improving the biosecurity measures and intensive disinfection, the antibody titer of monitored diseases had decreased. The positive rate of antibody of GPV, MDPV and DHV had decreased to 0 %,

0 % and 16.2%, respectively. The performance of egg laying and growing will be monitored every year. These embryonic eggs can be used to produce over million doses of live parvovirus vaccines. That can reduce the cost of vaccine for duck farmers and decreasing death of ducklings from waterfowl parvovirus.

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



Minimum disease Muscovy ducks

Development and application about selecting and breeding model in floor-raising breeding geese

The purpose of this study is to establish a new selecting and breeding model in geese under the animal welfare. Selecting 65 White Roman geese, 49 females and 16 males, from the fourth generation of high egg counts production line were reared together from starter to grower stage. All geese were randomly alloc-

ated into two treatments as cage and floor by their relationship individually at the beginning of reproductive season and fed laying diets *ad libitum*. The result indicated the laying behavior for geese which reared in floor space is earlier than in cage (2014/9/28 vs. 2014/10/20).

(S. C. Liao, S. C. Chang, M. J. Lin and Y. S. Jea)

Observations about reproductive traits of artificial reproduction in black swans in Taiwan

The aim of this study is observing the black swans reproductive behavior. Reproductive traits were collected from eighteen black swans in Chang-Hua station from September 2011 to February 2014. Currently known elements about black swan include that the number of egg related to age, 1-4 production cycle for each breeding season, 30-40 days for easy cycle, laid 1-7 eggs (4 eggs in average), 250 grams in weight for an egg and the natural incubation period which is affected by environment factors easily is 35-39 days. In short, Taiwan has the technology about artificial reproduction and the result of this study can be used as a reference to

promote the technology in the future.

(C. C. Hsiao and Y. S. Jea)



Black swans

Effects of time at first feeding on growth performance in Chinese geese goslings

The aim of this study is to evaluate the effect of time at first feeding after hatching on growth performance in Chinese geese goslings. Two hundred and forty goslings at age of one-day-old are randomly divided into four treatments and four replicates for each treatment. Feed and water were supplied *ad libitum* during 0-2 weeks. For treatment 1, the goslings are fed after hatching (control group). For treatment 2, 3, 4, the goslings with 3, 6, 24, hours delayed

to feed in post-hatch. The results indicated that time at first feeding goslings would effect on subsequent growth performance especial in Brown Chinese geese, but not in White Chinese geese. The average daily weight gain for geese about time at first feeding 0, 3, 6 hours after post-hatch groups was significantly heavier than 24 hours groups at age of two weeks ($P < 0.05$). The feeding efficiency about time at first feeding 0, 3, 6 hours after post-hatch groups

are significantly better than 24 hours groups at age of two weeks ($P < 0.05$). Therefore, the earlier feed goslings after post-hatch, the better absorbing ability of nutrient and growth



White Chinese geese

performance the goslings had. It suggested that time at first feeding for goslings shouldn't be over 6 hours after post-hatch.

(C. C. Hsiao and Y. S. Jea)



Brown Chinese geese

Food animal breeding research consortium (FABRC): Selection for high egg production line in White Roman goose

The breeding program is to select the high egg production line of White Roman goose. The experimental White Roman geese were born in 2004. The reproductive performance including laying age, body weight and egg weight at the first egg, egg production and laying period be investigated. The data of egg production and pedigree obtained will be analyzed with Best Linear Unbiased Prediction (BLUP) animal model, thereafter 25 ganders and 100 geese were selected as breeders to reproduce next generation. The results indicated that the age at first egg, body weight at first egg, egg weight at first egg, egg production, hatched egg, fertilized egg, gosling and laying period were 293 days, 5.52 kg, 130 g, 6,355 g, 46.1 eggs, 35.3 eggs, 23.3 eggs, 20.0 goslings and 109 days, respectively at the first lay number of the 4th generation geese. The body weight of the 5th generation male goose at hatching and 8 weeks old were 102 g and 4.53 kg, respectively; those of female geese were 101 g and 4.01 kg. We expect this breeding program will improve the ability of egg production of geese after

selecting 5 generations. In nearly future, high egg production line of White Roman goose is named as a new line, we will prove high quality goslings of the egg production line to commercial goose breeders and high quality goslings of the hybrid by the line of egg production mated the one of heavy body weight to the commercial goose farmers. Experimental results will be introduced with the productive benefit to commercial goose breeders and farmers.

(M. J. Lin, S. C. Chang, S. C. Liao, C. C. Hsiao, S. D. Wang and Y. S. Cheng)



The goslings of high egg production line in White Roman geese

Development of floor-rearing breeding model and raising technology in breeding geese

The purpose of this study was to exchange the experiences of the technology of raising goose and goose breeder selecting in Hungary.

The visit journey included to visit goose farmers, slaughter house, processing factory of feather and passageway of market. We

exchanged the experiences and technical raising goose feeding from Aug. 27, 2015 to Sep. 6, 2015. Later, we visited the scholars of Szent Istvan University to exchange the technology and some research projects of raising goose feeding in Hungary. The strains of Hungarian goose could be divided into meat, foie gras and down etc. The above-mentioned strains were all selected by commercial goose breeder. The selecting program was used the way of mating by one male and one female. To encourage the goose breeders to set up their own breeding

concepts in our country, we suggest them to cooperate with research institutes to improve the traits for the strains. Hence, the meat products of marketing are extensive in Hungarian goose; it was worth to follow in our country. We should increase the passageway of market in the export of goose products. After then, we can provide enough goose meat to general family at any time in the future and increase the selling market of goose meat.

(S. C. Chang and M. J. Lin)



The egg-hatching equipment of animal experimental field in Szent István University



The feeding of Landaise of animal experimental field in Szent István University

Animal Nutrition

The effect of graded levels of sweet potato to substitute the corn in diets on growth performance and carcass characteristics of crossbred pigs

A total of 40 LD (Landrace × Duroc-Jersey) crossbred pigs, average body weight (BW) 45 kg, were used as experimental animals. Pigs were allocated into 4 treatments according to their BW and fed with four diets, i.e. control, graded levels substitution of corn in control diet by sweet potato (SP), 20%, 40% and 40% added lysine (SP20, SP40, SP40+Lys). Feed and water were provided *ad libitum*. When BW of the pigs reached approximately 120 kg, 6 pigs from each treatment were slaughtered and the carcass characteristics were measured. Growth performance, carcass characteristics, chemical compositions and panel test of loin meat were evaluated. The results showed that the average feed intake and daily gain of pigs decreased

with the increasing levels of substitution. Pigs provided with SP20 diet had higher feed conversion rate during growing period and lower backfat thickness. There was a trend for lower crude protein and higher fat percentage in meat from pigs fed SP40+Lys diet. The lean percentage of pigs in SP40+Lys group was significantly ($P < 0.05$) lower than those in the other groups. The color score of loin meat decreased when the substitution levels increased. In conclusion, the substitution of corn by sweet potato in diet for growing-finishing crossbred pigs of 20% is recommended.

(C. W. Liao, G. J. Fan, T. C. Yang, H. F. Lee, W. S. Chen and C. F. Lee)

Effect of the extracted plant polysaccharide on intestinal microflora, immunity and growth performance of post-weaning pigs

The purpose of this study was to assess the effect of adding polysaccharide extracted from wheat bran (WBPE), alfalfa (APE), or napiergrass (NPE) into diets at 0.1% ratio on the intestinal microbial phase, immune response, and growth performance of postweaning piglets. A total of 32 head of 4-wk-old LYD crossbred weaning piglets were used. Piglets were housed in 16 nursery pens according to their weight and gender (1 male 1 female per pen) for 4 weeks. All diets have 18% of crude protein and 3,400 kcal/kg digestible energy. Three experimental diets contained one of the plant polysaccharide at 0.1% level. Plant polysaccharides were extracted from hot water. The lowest polysaccharide content extracted is from alfalfa only 9.0%, following from wheat bran 22.6% and the highest content is from

napiergrass 35.1% (dry matter basis). At the first week, piglets fed 0.1% NPE had significantly better feed efficiency than those fed 0.1% APE. At the fourth week, the daily weight gain of piglets fed 0.1% NPE was significantly higher than those fed 0.1% WBPE. Piglets fed diet with 0.1% polysaccharides from napiergrass, alfalfa or wheat bran possessed three (IL-1 β , IL-6 and IL-8), two (IL-6 and IL-8), or one (IL-1 β) kinds of inflammation inhibiting factors higher than those fed control diet, separately. Regarding the gut microflora, diet with NPE could significantly inhibit the intestinal *E. coli* number of piglets than diet with APE. On the 15th day, piglets fed 0.1% of NPE also had a higher amount of intestinal lactobacillus than piglets fed control diet.

(F. C. Liu)

Effects of plant polysaccharide and cellulolytic bacteria on intestinal microflora, immunity and growth performance of post-weaning pigs

The purpose of this experiment is to evaluate the combination effect of napiergrass polysaccharide extract (NPE) and cellulolytic

bacteria (CB) added into diets on intestinal microflora, immunity and growth performance of weaned piglets. A total of 40 head of 4-wk-old

LYD crossbred piglets were allotted in 20 pens according to their body weight and gender (1 male and 1 female per pen) for 4 weeks. Diets for all four groups contained 18% crude protein and 3,400 kcal/kg digestible energy. Basal corn-soybean diet acted as control diet. Two treatment diets included 0.1% NPE and either No.2 or No.9 CB added at 1×10^8 cfu/kg. Diet with antibiotic addition acted as a positive control group. Feed and water were offered *ad libitum*. Results showed that diet containing antibiotics could improve the daily weigh gain of piglets

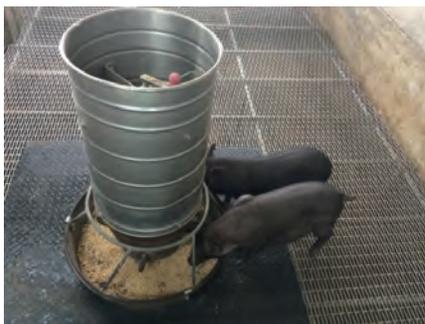
for the first two weeks and the daily feed intake for the first and the fourth week. Diet containing NPE and No.2 CB could significantly enhance piglets the blood IgA and IgG concentration, suppress the inflammatory factors IL-1 β , IL-6 and IL-8, significant increase the intestinal lactobacillus counts and decrease the number of *E. coli*. Diet containing NPE and No.9 CB also could significantly inhibit the blood IL-6, IL-8 contents and the intestinal *E. coli* number.
(F. C. Liu)

Effect of dietary crude protein and metabolizable energy on growth performance and backfat thickness of Lanyu pigs

The purpose of this experiment was to evaluate the metabolizable energy (ME) and protein requirement of Lanyu miniature pigs during growing period. The pilot study was carried out to determine the *ad libitum* feed intake, as a reference for later feed restriction studies. The experiment was conducted as a 2 \times 2 factorial design. Corn-soybean meal diets were formulated to have 13 or 16% crude protein (CP) and 2,800 or 3,100 kcal/kg ME. Water and feed were fed *ad libitum*. Body weight, feed intake, weight gain and feed conversion ratio (F/G) were recorded at the 7th, 12th and 17th weeks of age. Blood were sampled for plasma characteristic analysis. The results showed Lanyu pigs provided the diet with CP 16% have

the higher feed intake and daily body weight gain during 7-12 wks, 12-17 wks and 7-17 wks of age ($P < 0.05$). There were no significant differences in feed conversion ratio among treatment groups. Pigs fed ME 3,100 kcal/kg regardless of CP diet had the thicker increment of backfat during 7-12 wks and 7-17 wks of age ($P < 0.05$). No abnormalities in blood chemistry occurred in *ad libitum* fed Lanyu pigs. The present results indicated that the strategy of restricted feeding for Lanyu miniature pigs warrant further research in order to reduce its backfat thickness.

(L. C. Chen, C. K. Chen, H. P. Chu and C. W. Liao)



Ad libitum feeding



Measurement of swine backfat thickness

Effects of diets supplemented with two-phase solid-state fermented feedstuff on production and immunity performance of sows and their suckling piglets

This study was conducted to determine the effect of supplementation of two-stage solid-state fermented powder (TSFP) in diets for Duroc \times KHAPS (Kaohsiung Animal Propag-

ation Station) black sows on production and immunity responses of sows and their suckling piglets. Five different diets were formulated to be iso-crude protein (gestation 12.8% and

lactation 17.5%) and iso-caloric (ME 3,265 kcal/kg). A total of 40 KHAPS sows were randomly assigned into 2% fish meal group (control), or fish meal was replaced by 0, 1%, 2% or 3% of TSFP. Feed was restrictly provided 2.2 kg per day per sow at gestation period and *ad libitum* at lactation period. Results of the production performance showed that sows fed 2% and 3% TSFP diets had the higher ($P < 0.05$) daily body weight gain during gestation (75-107 days) and daily intake during lactation period than the other three groups. Sows fed 2% and 3% TSFP diets also promoted the higher feed intake (day 8-weaning) of their suckling piglets ($P < 0.05$) than piglets in 0 and 1% TSFP groups.



The lactating Duroc × KHAPS black sow and piglets

Serum immunity competence results showed at weaning sows and their piglets had the highest gamma interferon (IFN- γ), immunoglobulin A, polymorphonuclear granulocyte concentration and phagocytosis activity ($P < 0.05$) when sows were fed the 2% or 3% TSFP diets. However, there was no significant difference in oxygen burst activity of granulocytes. The current results indicates diet supplemented with 2% TSFP can get the better production performance and immunity competence of sows than the control 2% fish meal diet. The optimal supplemental level of TSFP was 3%.

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



Two-phase fermented-probiotic soybean-feather meal with the appearance of pale yellow, powder and no pungent smell

Effects of dietary inclusion of two-stage mix-probiotics fermented feedstuff on growth and immunity performances of weanling piglets

The study was conducted to determine the effects of two stage fermented feedstuff (TSFF) supplemented feed on growth traits and immunity of Duroc × KHAPS (Kaohsiung Animal Propagation Station) black weanling piglets. *Bacillus subtilis* natto (N21), a selected strain with higher proteolytic capacity was inoculated in the initial fermentation stage. The specific strain of *Lactobacillus sporogenes* (L12) with higher acidic capacity was added in the following fermentation stage. The raw ingredients used as substrate for the fermentation were a mixture of 60% soybean meal and 40% hydrolyzed feather meal. Four different dietary treatments were formulated to be iso-crude protein (CP 20.9%) and iso-caloric (ME 3,265 kcal/kg). A total of 112 head black piglets with an initial body weight of 9.24 ± 1.02 kg were randomly assigned into 4 treatment groups with 7 replications each. Each replication had 2

barrows and 2 gilts. Control diet was formulated to have 5% fish meal, whereas fish meal was replaced by 1, 3 or 5% TSFF for treatment groups. During the 6-wk feeding trial, feed and water were provided *ad libitum*. Results showed that body weight gain and serum total protein of piglets fed 5% TSFF were higher than those fed 1% TSFF diet ($P < 0.05$). Piglets in the 5% TSFF group had the lowest serum urea nitrogen among groups and the higher serum concentration of gamma interferon (IFN- γ), IgA and high density lipoprotein protein than those in 5% fish meal and 1% TSFF group, respectively ($P < 0.05$). Our current results indicates the weanling piglets diets supplemented with 5% TSFP can get the better growth performance and immune competence than the control diet with 5% fish meal.

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

Effects of dietary replacement of corn with sweet potato (Tainung 66) on growth performance and carcass characteristics of black pigs

Objective of this study was to investigate the effects of diets containing different levels



Tainung 66 sweet potato and its chips

of sweet potato (Tainung 66) to replace corn on the growth performance and carcass characteristics of black pigs. A total of 48 black pigs (average body weight (BW) 27 kg) were randomly divided into 4 treatment groups and fed one of the four diets, i.e. the corn-soybean meal basal diet (control), control diet with 15% (SC15) or 30% (SC30) corn was substituted by sweet potato and SC30 diet but adjusted to have isonitrogen and energy with control diet (SC30A), respectively. Feed and water were provided *ad libitum*. Pigs were fed the finisher diets when the average BW reached 60 kg. When BW reached 113 kg, six pigs from each treatment were sacrificed for measurement of carcass characteristics. Results showed that growth performance and carcass characteristics of black pigs were not affected by diets. However, the loin meat marbling score and overall acceptance in panel test of SC30 group was lower than that of the SC30A group ($P < 0.05$). In addition, the juiciness and tenderness of the meat from control group were the best among four diets. When the dietary crude protein and ME are adjusted to the standard level, substituting 30% corn by sweet potato for growing-finishing black pigs is acceptable.

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

Effect of *houltuynia cordata* content on growth and immune response of piglets

The aim of this study was to explore the effect of dietary supplementation with different amounts of *Houttuynia Cordata* powder (HC) on the growth and immune response of piglets. A total of 48 heads of 4-wk-old TLRI Black Pigs (TBP) were allocated into four treatments, i.e. HC added into diets at 0 (control), 10 kg (H10), 20 kg (H20) or 40 kg (H40) per ton for six weeks. There were three replicates (pen) of each treatment. Water and feed was provided *ad libitum* during the test. Blood of each pig was collected at the beginning and the end of the test. Body weight of each pig and the feed intake of each pen were measured weekly during the test. Diarrhea incidence was recorded to

calculate the diarrhea index. The results showed that the weight gain of overall period of H40 group was lower than the other three groups ($P < 0.05$). Body weight gain between H10 and H20 groups was similar, but both were higher than that of control group ($P < 0.05$). Diarrhea index was not different among treatments. After 28 days of continuous feeding, H10, H20 and H40 groups all had the higher index of lymphocyte proliferation than that of the control group. The blood ALT, AST, cholesterol and creatinine were not different among treatments indicating there was no impact on liver and kidney toxicity especially in the administration of high dose of H40. According to the results above, it is

recommended that supplemented with 20 kg/ton of *Houttuynia Cordata* powder in weaner diets can promote the growth and the immunity of

piglets.

(C. J. Wu and C. C. Chang)

Effect of dietary supplementation of *Gracilaria lemaneiformis* meal on laying performance and egg quality and panel test of leghorn layers

Gracilaria lemaneiformis was a seaweed enriched in mineral content. Effects of dietary supplementation of *Gracilaria lemaneiformis* meal (GLM) on laying performance and egg quality and consumer preference of leghorn layers were studied. A total of 200 layers at 35-wks-age were randomly assigned into five diet treatments for eight weeks. A corn-soybean meal basal diet was provided as the control diet and GLM was added into diets at 1%, 2%, 3% or 5% levels for the other four groups. Results indicated that the daily feed intake, egg weight, shell break strength, shell thickness, shell weight percentage and Haugh units were not affected by GLM supplementation. Daily egg production percentages and egg mass were higher for layers fed GLM 1% to 3% diets when compared with

the control and 5% GLM diets ($P < 0.05$). The brightness of yolk from layers fed 3% GLM diet was the highest among treatments ($P < 0.05$). Results from panel test showed that eggs produced from 2% GLM group had the higher color score ($P < 0.05$). Consumers accepted the eggs more from the control, 1% and 2% GLM groups ($P < 0.05$). When fed GLM 5% diet, the intent of purchase of consumers was decreased ($P < 0.05$). Glucose, uric acid nitrogen, triiodothyronine and tetraiodothyronine contents in blood increased with the increasing GLM level. In conclusion, the suitable amount of GLM supplementation for layer diet was recommended to be 2% to 3%.

(B. L. Shih, H. Q. Lin, G. J. Fan and C. F. Lee)

Effect of replacing dietary corn by Tainung 66 sweet potato on growth performance and carcass traits of native chickens

To build up the proper utilization of local feed ingredients for livestock, this experiment was conducted to study the effects of dietary replacement of corn by Tainung 66 sweet potato on growth performance and carcass characteristics of native chickens. A total of 330 day-old male chickens were randomly assigned into five groups. A corn-soybean meal basal diet was offered for the control group. Tainung 66 sweet potato was used to replace 10%, 20%, 30% or 40% of the corn in starter and grower diets (0-8 wks) and 20%, 30%, 40% or 50% of the corn in finisher diet (9-16 wks). Feed and water were offered *ad libitum* during the 16 wks trial period. At the end of experiment, eight chickens from each treatment were sacrificed for

measuring the carcass characteristics. Results showed that feed intake, survival rate and dressing percentage of chickens were not affected by sweet potato replacement. However, replacing more than 30% in starter-grower period and more than 40% in finisher period of corn by sweet potato adversely lower the weight gain and feed conversion ratio ($P < 0.05$). Meanwhile, chickens fed higher sweet potato diet showed the lighter yellow color of breast meat and skin ($P < 0.05$). In conclusion, there is restriction in using the sweet potato in diets for chicken. The optimal replacement of corn by sweet potato in native chicken diet was 20% in starter-grower period and 30% in finisher period, respectively.

(B. L. Shih, G. J. Fan and C. F. Lee)

Effect of dietary replacement of corn with feed rice (Taichung Sen 17) on the growth performance, carcass trait and meat quality of red-feathered Taiwan country chickens

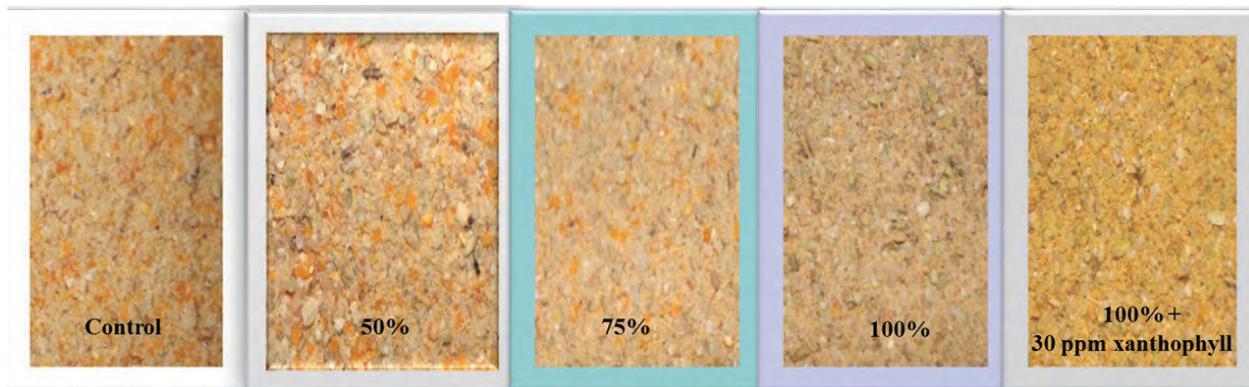
To explore local feed resource, effect of corn substituted by feed rice (Taichung Sen 17) was studied. A total of 360 day-old commercial

red-feathered Taiwan native chickens were randomly assigned into five treatment groups for 13 wks. Each group had 4 repeat pens. Diet

treatments included substitution ratios at 0% (control, corn diet), 50%, 75%, 100% (feed rice diet) or 100%+30 ppm xanthophylls. Feed and water were provided *ad libitum*. Results showed that only in starter period the 100% corn substituted group had the lower feed intake but better feed conversion ratio than that of control group ($P < 0.05$). During the growing, finishing and full period, feed intake and feed conversion ratio were not affected by the rice substitution. In addition, rice substitution levels also did not affect the daily weight gain, mortality, dressing percentage, abdominal fat percentage and organs weight percentage. However, the 75% and 100% substitution groups had lowered b^* (yellowness) value in the breast skin and a^* (redness) value in the breast muscle than that of control group. Furthermore, the fat content, drip loss and cooking loss of breast muscle were higher but

the firmness and toughness were lower in 100% rice group when compared with control group. Therefore, breast meat produced from control group had the higher panel test scores than that from 100% rice group for their better aroma and flavor. The addition of 30 ppm xanthophylls did not change the chickens growth performance, most of the carcass traits and the taste, whereas the 30 ppm xanthophyll contributed to the greater b^* value in both the breast skin and muscle. It is concluded 100% substituting corn by feed rice would not influence the growth performance and carcass traits of native chickens, but caused a significant decrease in skin and muscle color, muscle firmness, toughness and taste.

(C. Y. Lin, K. J. Liang, S. R. Kang, R. J. Tu and H. L. Lee)



Graded levels of substitution of corn by feed rice



Red-feathered Taiwan native chickens

The effect of dietary substitution of corn by sweet potato on mule duck growth performance and carcass traits

This experiment was designed to investigate the effect of dietary substitution of corn by

sweet potato on mule duck's growth and carcass traits. A total of 240 3-wk-old mule ducks were

randomly allocated into four treatments and raised to 12-wk-old. The first treatment was given a corn and soybean meal basal diet as control group, the second to fourth treatments sweet potato were used to substitute for 15%, 30% and 45% corn of basal diet respectively and all treatment diets were adjusted to be isocaloric and isonitrogenous. There were three replicates for each treatment with 20 ducks each pen. The feather growth condition, body weight and feed consumption were recorded at 3, 7, 10



Mule duck at 12 weeks of age

and 12 weeks of age. Two ducks chosen randomly from each pen were sacrificed for carcass traits determination. The results indicated that for live body weight at 12 weeks of age, the 15% substituted group had 2,772 g of body weight which was higher than those in the other three groups ($P < 0.05$). The 15% substituted group had a total 2,254 g of body weight gain, higher than control group and 45% substituted group ($P < 0.05$). In feed conversion ratio, all groups showed results within a range of 4.78-5.02 and no differences among groups. In length of primary feathers, the control group had shorter primary feather than the other three groups ($P < 0.05$). In breast weight, 501 g breast weight was observed in the 15% substituted group, higher than the control group and 45% substituted group ($P < 0.05$). From results of this experiment, the diet had 15% corn replaced by sweet potato could improve mule duck's body weight, body weight gain and breast weight.

(C. H. Su, J. H. Lin, Y. A. Lin, C. H. Cheng and J. F. Huang)

Effects of feeding program and lighting condition on fertility of ganders

II. Effects of lighting and feed restriction during developing period on testis development of ganders

This study was to investigate the effects of feed restriction and lighting treatments on sexual maturity of White Roman ganders. At 12-wk-age, 224 ganders were distributed into two feeding treatments. Control group was fed *ad libitum* (AL) and the other group was offered a restrict amount of feed of 70% feed consumed by control from previous week (R70). There were 8 pens in both treatments. Ganders received a diet with crude protein 14.2% and ME 2,616 kcal/kg. At 20 weeks of age, both groups were reassigned into 3 lighting regimes, i.e., 9L40x (9 h light of photoperiod and 40 lux of lighting intensity), 9L400x or natural lighting. From this moment, all ganders received a diet with 18% crude protein and 2,650 kcal/kg ME *ad libitum*. Semen was collected weekly by dorso-abdominal massage. Age at sexual maturity of each gander was determined by its sperm activity evaluated by microscope checking. Body weight when proper activity achieved was defined as body weight at sexual

maturity. Body weight of ganders in R70 group at 20-wk-age was lower for 6.71% than those in AL group ($P < 0.05$). Compared with natural lighting, feed intake and body weight at sexual maturity of two artificial lighting groups was obviously different. But, no significant effect between 40 lux and 400 lux of lighting intensity was observed. The lower body weight of ganders could help the mating efficiency. It was concluded that 30% feed restriction could be adopted on White Roman ganders during the early stage. After 20-wk-age, ganders exposed to 9 h light of photoperiod and 40 lux of lighting intensity could reduce their feed intake and result a smaller body weight at sexual maturity. This raising regime also advances the age at sexual maturity of ganders.

(S. D. Wang)

Improvement of silage quality by mixing pineapple pulp with *Flammulina velutipes* wasted culture or rice straw

Pineapple pulp (PP) rich in water soluble carbohydrates and fiber is the by-products from pineapple processing. The high moisture content limits its transportation and utilization. On the other hand, *Flammulina velutipes* wasted culture (FC) and rice straw (RS) are both drier and highly fibrous material with low digestibility. The aim of this study was to design the proper mixing ratios for PP and FC silage (PFS) and PP and RS silage (PRS) so as to promote their silage dry matter (DM) content and fiber digestibility. Eight PFS were formulated by mixing PP and FC from 0.5:1 to 3:1 ratios (fresh weight basis). From 3:1 to 10:1 ratios, eight PRS were formulated from PP and RS. Each mixed material was ensiled in the black plastic water pipes with ca. 10 L of volume for 28 d. PP silage got the Flieg's score of 49 while the FC silage

got only 16 points. Flieg's scores ranged from 70 to 80 points for PFS, but in vitro dry matter digestibility (IVDMD) were reduced, from 38% to 34%, with the increasing ratios of FC in the silages. For eight PRS, IVDMD ranges from 37.5% to 47.3% and Flieg's score ranged from 69 to 77 points. After ensiling, PFS and PRS have the averaged CP of 8.1%, NDF of 66.1%, ADF of 44.7%, IVDMD of 39.5% (DM basis) and pH of 3.70. Comparing with pre-ensiling stage, ensiling process increased 2.1% in ADF, decreased IVDMD by 3% and lowered pH value by 0.9 units. The physical outlook, color and smell of PFS and PRS were medium to high quality and thus suitable for ruminant feed.

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

Effects of dietary supplementation of pineapple pulp and *Flammulina velutipes* culture silage on growth performance of dairy goats

To explore the local by-products feed resources, this study was aimed to study the feeding value of two by-products of high quantity, pineapple pulp and *Flammulina velutipes* culture, for growing dairy goats. Pineapple pulp and *Flammulina velutipes* wasted culture (PFS) were mixed at 1:1 fresh weight ratio and ensiled into 20-kg volume pails. A total of 30 head of Saana and Alpine castrated ram (18 heads) and maid (12 heads) with average body weight of 53.9 kg were assigned into three groups, 5 pens (2 head/pen) each group. Feeding trial was conducted for 62 days. Control diet used corn silage and pangolagrass hay as main forage. By substituting

partially the two forages, PFS was added into trial diets at 8% or 16% of the diet dry matter. Results showed that application of PFS did not influence goats' daily dry matter intakes and weight gains. Dry matter intakes of control, 8% and 16% three groups reached 1.23, 1.37 and 1.39 kg a day. Body weight gain reached 63, 69 and 86 g per day, respectively. In conclusion, PFS could be an alternative feed resource for growing dairy goats and a diet with 16% of PFS is recommended.

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

Effects of dietary supplementation of pineapple pulp and *Flammulina velutipes* culture silage on milking performance of dairy goats

To explore the local by-products feed resources, this study was to study the feeding value of two by-products of high quantity, pineapple pulp and *Flammulina velutipes* culture, for lactating dairy goats. Pineapple pulp and *Flammulina velutipes* wasted culture (PFS) were mixed at 1:1 fresh weight ratio and bag ensiled. A total of 20 head individually fed lactating Saanen and Alpine goats with daily milk yield

above 2 kg were assigned into 28-d feeding trials twice. Control diet used corn silage and pangolagrass hay as main forage. By substituting part of the main forage, PFS was added into trial diets at 4, 8 or 12% diet dry matter. Results showed that the dry matter intakes (DMI) and milk yield of goats fed 4% PFS were higher than those fed 12% PFS diet. DMI of control, 4, 8 and 12% PFS groups reached 2.29, 2.44, 2.25

and 2.09 kg; milk yields were 2.30, 2.40, 2.32 and 2.20 kg ($P < 0.05$). Milk fat 4.16% from goats fed 12% PFS diet was higher than those from 4% PFS group, 3.75%. Goats in control group had the higher milk total solid of 12.15% than those from 4% PFS group, 11.66%. The

other milk compositions were similar among groups. In conclusion, PFS could be an alternative feed source for lactating dairy goats and a diet with 8% PFS is suggested.

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

Proper utilization of tomato pomace in diets for lactating dairy goats

Tomato pomace is the by-products from ketchup or juice processing. However, the high moisture content limits its transportation and preservation for feed. To build up the environmentally protective feeding system by adoption of local feed ingredients, this study was aimed to study the ensiling method for tomato pomace and its proper utilization in diets for lactating goats. Tomato pomace and corn meal (TPC) were mixed at 10:1 fresh weight ratio and ensiled in big plastic bag. TPC had pH value of 3.71, dry matter of 26% and crude protein of 16% (DM basis). A total of 20 head of Saanen and Alpine goats were randomly assigned into four groups and raised in individual pens in a 28-d feeding trial. TPC silage was added into four treatment diets at 0, 6, 10 or 15% (DM basis) by substituting part of the distiller's grains and corn in control diet. Results showed that four diets could support goats to have similar

daily dry matter intake (1.87, 1.72, 1.85 and 1.72 kg), milk yield (2.22, 2.02, 2.17 and 1.88 kg) and milk compositions including milk fat (avg. 4.24%), protein, lactose and total solid. Dry matter intake and milk yield from goats fed 15% TPC silage diet were numerically lowered. In conclusion, tomato pomace could be well preserved as silage for feed resource. A diet for lactating dairy goats with 10% of TPC silage is recommended.

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



Tomato pomace and corn meal were mixed at 10:1 fresh weight ratio and ensiled

Effects of feeding new napiergrass variety 2504 on lactating performance of dairy goats

Napiergrass (*Pennisetum purpureum*) is one of the major forages for ruminant in Taiwan. The newly selected medium-height 2504 variety has the better quality than cv.TLG2 and higher yield than cv.TLG3. This study was aimed to evaluate its feeding value for lactating dairy goat. Napiergrass cv.TLG2 and 2504 variety were chopped and ensiled in 20 kg pails separately. A total of 21 head of Saanen and Alpine goats were assigned into three treatments and individually fed in two feeding trials with 28-d each. Diets constituting of 25% of corn silage, napiergrass cv.TLG2 or 2504 variety in dry matter basis were formulated. Two napiergrass diets were supplemented with an extra corn meal to make all diets isocaloric. Results showed that three diets could support goats to have similar daily dry matter intake, milk yield (2.20, 2.19 and

2.28 kg) and milk compositions, milk fat (3.50, 3.61 and 3.39%), protein, lactose and total solid. It was suggested after compensating dietary energy, napiergrass cv.TLG2 and 2504 variety are available forages for lactating dairy goats because they could achieve the similar lactating performance of goats as that of corn silage diet.

(G. J. Fan, B. L. Shih, T. R. Li, J. B. Lin, T. F. Shiao and C. F. Lee)



Napiergrass 2504 and cv.TLG2 in field

Effect of using *Glycine Max* in diets on growth performances and carcass characteristics for growing-finishing goats

Twelve 7-month-old castrated Kenting goats were randomly assigned into control group or *Glycine Max* group, with 3 replicates in each group. Feeding trials were carried out for 181 days. Diets of both groups contained 14.6% of crude protein. Control diet was formulated to have 70% of grain concentrate and 30% of bermudagrass hay and *Glycine Max* diet had 87.6% of *Glycine Max* silage, 2.4% of soybean meal and 10% of bermudagrass hay. At the end of trial, three goats from each group were slaughtered to evaluate carcass traits. There were no significant differences on daily weight gain (163 ± 53 vs. 119 ± 9 g), daily dry matter intake (1.064 ± 0.260 vs. 0.897 ± 0.058

kg) and feed conversion rate (6.67 ± 0.72 vs. 7.55 ± 0.22 , intake/gain) between control and *Glycine Max* groups, respectively. Feed cost per kg of weight gain of control group was 112.09 ± 12.08 NTD, which was significantly higher than that of *Glycine Max* group of 70.95 ± 2.11 . With respect to carcass characteristics, significant differences were not seen in dressing percentage, approximate compositions, quality characteristics, amino acid composition and fatty acid composition between groups. In conclusion, feed cost can be decreased by adding *Glycine Max* into daily diets for growing-finishing goats. (S. S. Yang, R. H. Yeh, I. C. Chou, D. C. Wang and J. C. Huang)



Glycine Max silage



Feeding trial

Effect of adding Natto fermentation product in milk replacer on growth performance for goat kids

The purpose of this study was to investigate the effect of adding Natto fermentation product in milk replacer on goat kids' growth performance. Fifteen goat kids of 10-17 days of age were randomly assigned into three groups

with five replicates each for three months. Goats fed with replace milk (milk replacer:water = 1:9) containing 0, 0.1, or 0.3% of Natto fermentation product. The amount of milk offered gradually increased from 1,020 to 1,800 mL a day during



Individual feeding cages



Milk feeding of kids

the first 1.5 month of experimental period and then reduced to 400 mL a day. Corn-soybean grain mixture was offered after one month and hay offered after two month of the experimental period *ad libitum*, respectively. Body weight and dry matter feed intake were recorded every month. At the end of trial, blood samples were collected for analysis of biochemical compositions (GOT, ALP, TP, BUN, GLU, Ca, P). Results showed that total body weight gain of goat kids in these 3 groups were similar and

achieved 11.7 ± 1.4 , 10.2 ± 1.8 and 10.4 ± 1.1 kg and FCR (Intake/Gain) were 1.52 ± 0.17 , 1.77 ± 0.32 and 1.69 ± 0.19 , respectively. All goat kids were healthy. There were also no differences in blood biochemical values among groups. In conclusion, adding 0.1 to 0.3% of Natto fermentation product in milk replacer had no improvement effect on goat kids' growth performance.

(R. H. Yeh, I. C. Chou, S. S. Yang, D. C. Wang and J. C. Huang)

Effect of *B. subtilis* natto supplementation on growth performance and diarrhea occurrence for weaning goat kids

The purpose of this study was to investigate the effect of adding different concentrations of *Bacillus subtilis* natto (Bac) in diets on diarrhea occurrence, growth performances and blood characteristics of goat kids around weaning. Forty-eight 10-day-old Alpine goat kids were assigned into four groups containing 0 (control), 0.1, 0.3 or 0.5% of Bac (2.6×10^{10} CFU/g) in diets as treatments. Feeding trial last for 8 weeks. Kids were weaned at the 4th week of experimental period. Body weight, feed intake, feed conversion ratio, diarrhea scores and feces microflora were recorded each week. The results showed that Bac supplementation group had the higher body weight and weight gain after weaning ($P < 0.05$). Bac supplementation

improved feed conversion ratio in whole experimental period and after weaning period ($P < 0.05$). During the 4th to 8th week, Bac supplementation improved diarrhea scores ($P < 0.05$). The concentration of hemoglobin in the 0.5% Bac group was lower than those in 0.1% Bac group at the 8th week ($P < 0.05$). The proportion of eosinophil granulocyte in the control and 0.1% Bac group were higher than that in 0.5% Bac group ($P < 0.05$). In conclusion, dietary Bac supplementation 0.1% could decrease the diarrhea occurrence, improve the body weight gain and feed conversion ratio after weaning for goat kids.

(T. Y. Li, C. P. Wu, R. H. Yeh, P. A. Tu, D. C. Wang, J. C. Huang and K. L. Chen)

Effects of dietary supplementation of pineapple pulp and *Flammulina velutipes* culture silage on milking performance of Holstein lactating cows

To explore the local feed resources, this study was to evaluate the proper utilization of two high quantity by-products, pineapple pulp and *Flammulina velutipes* wasted culture (PFS), in diets for Holstein lactating cows. High sugar pineapple pulp and high fiber wasted culture was mixed at 1:1 fresh weight ratio, bag ensiled and resulted in 29.9% of dry matter and 9.5% of crude protein (DM basis). A CRD feeding trial with 2-wks of covariate adjustment was adopted and repeated. A total of 48 Holstein lactating cows were assigned into four groups receiving diets containing 0 (control), 3, 6 or 9 kg (as fed basis) of PFS a day a cow for 24 days. Results showed that the daily dry matter intakes of four groups reached 19.2, 17.6, 18.6 and 19.9 kg.

Daily milk yields were 23.5, 22.6, 23.8 and 24.1 kg, respectively. Milk fat, protein and solid not fat contents were similar among groups and all averaged as 3.54%, 3.31% and 8.62%, respectively. Diurnal rumen pH measured from cows fed control diet or 6 kg of PFS diet were 6.40 and 6.16. Adding PFS in diets tended to lower the rumen pH. Income over feed cost of cows fed PFS 6 kg and PFS 9 kg increased 3% when compared with that of the control group. In conclusion, PFS could be an alternative feed source for lactating Holstein cows. A diet with 6 kg to 9 kg of fresh PFS is recommended.

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

Effects of dietary supplementation of vitamin E and selenium on milking performance and blood biochemical traits of Holstein lactating cows during the monsoon season

High humidity during rainy days causes stress in lactating cows. The purpose of this study was to evaluate the effects of dietary supplementation of vitamin E and selenium (Se) on milking performance and blood biochemical traits of Holstein lactating cows during the rainy season (April and May). A complete randomized design with 10 days of covariate adjustment was adopted. A total of 24 Holstein lactating cows were assigned into two groups according to their body weight, milk yield, parity and days in milk. Cows received nutrition balanced diet as control group (NRC, 2001). The treated group received diet with extra 500 IU of vitamin E (increased 25 IU/kg of diet) and 8 mg of organic Se (increased 0.4 ppm of diet) a day for 20 days. Results showed increasing vitamin E and Se supplementation tended to increase cow dry matter intakes ($P = 0.11$) and decrease milk somatic cell count ($P = 0.16$). The other milk compositions were not affected. Cows fed extra vitamin E and Se had higher blood phosphorus content ($P < 0.05$). Enzyme activities of

blood creatinine kinase, glutamate-pyruvate transaminase and lactate dehydrogenase were not affected. It is suggested that promoting the supply of vitamin E and Se to lactating cows diet seems to have protective effect for cow health during rainy season.

(C. T. Chang, T. F. Shiao, D. W. Yang, H. W. Ou, C. H. Hsieh and C. F. Lee)



Cow feeding trial

Effects of dietary supplementation of organic chromium on milking performance and blood biochemical traits of Holstein lactating cows during the monsoon season and hot summer

To relieve the heat stress of Holstein lactating cows, this study was aimed to evaluate the supplementation benefits of organic chromium (Cr) during the rainy month (April and May) and hot season (June and July). Milking performance and blood biochemical response were measured. A complete randomized design with 10 days of covariate adjustment was adopted. A total of 24 head of Holstein lactating cows were assigned into two groups according to their body weight, milk yield, parity and days in milk. Cows received diet containing 0 (control) or 0.5 ppm of organic Cr a day for 20 days. The calculated THI averaged 78.6 in rainy season and 82.7 in summer season, respectively. Results showed that dry matter intake and milk efficiency (milk/intake) of cows supplemented with Cr were tended to increase. Milk composition results showed the milk

solid-not-fat concentration was increased by supplementing organic Cr during both stressful seasons. Adding of organic Cr had tendency to decrease the milk somatic cell counts in rainy season, but not during summer season. In blood biochemical response, Cr supplementation tended to decrease the serum glutamic oxalacetic transaminase activities, but the enzyme activities of creatinine kinase, glutamate-pyruvate transaminase and lactate dehydrogenase were not affected by Cr supplementation. In conclusion, adding organic Cr at dietary 0.5 ppm level had a tendency to relieve stress during the rainy season and hot season for Holstein lactating cows.

(C. T. Chang, T. F. Shiao, D. W. Yang, H. W. Ou, C. H. Hsieh and C. F. Lee)

Effects of supplementation of rumen by-pass amino acids and crude protein level in diets on antlers production and blood biochemical values in Formosan sambar deer

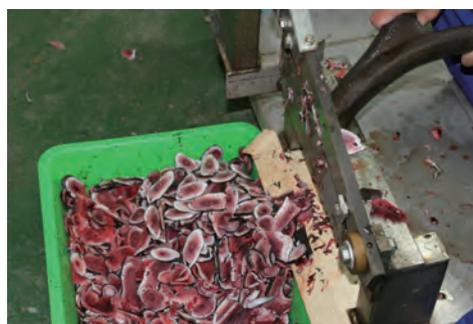
The study was conducted to determine the effects of supplementation of rumen by-pass lysine and crude protein (CP) concentration in diets on the antlers production of Formosan sambar deer (*Crevus unicolor swinhoei*). Sixteen Formosan sambar deers were randomly assigned into A, B, C or D groups by age and last year velvet antlers production. Diet was offered as a totally mixed ration (TMR) and formulated to have CP 13% (A groups), CP 13%+0.1% rumen by-pass lysine (B), CP 13%+0.2% rumen by-pass lysine (C), or CP 15% (D), respectively. The results showed that D group had the highest apparent crude protein digestibility ($P < 0.05$).



Corn silage with Flieg's score of 78

Length of right velvet antler of B and D groups were higher than that of A group ($P < 0.05$). There were no obvious difference in chemical compositions of velvet antler, weight of velvet antlers and blood biochemical values among treatments. Summarizing our current results indicates higher dietary CP concentration from 13% to 15% or supplementation of rumen by-pass lysine on the CP 13% diet could increase the length but not the weight of velvet antlers. However, economic evaluation indicates that Formosan sambar deer fed TMR with 15% CP has the higher profits return than the other diet treatments.

(H. J. Huang, H. H. Lin, C. B. Hsu, S. R. Kang and C. Y. Lin)



Freshly harvested antlers

The *in vivo* nutrient digestibility of forage for rabbits

A total of 48 male growing rabbits, 8 wks of age, were allocated into 6 groups. Control diet was formulated to contain crude protein 16.9% and crude fiber 11.3%. Taking 80% of control diet mixed with ground forage, pelleted and then fed the rabbits for nutrients digestibility measurement. A time to time total feces collection method was used. The result showed that digestibility of crude fiber for locally produced alfalfa reached 17%, crude protein 79.5% and gross energy digestibility 79.5%. Crude protein digestibility of sweet potato vine

was 81.9% and for crude fiber, 25.6%. Crude fiber digestibility of peanut vine reached 31.2%. Crude protein digestibility of pangolagrass and napiergrass was 78.2% and 41.2%, respectively, nevertheless, for crude fiber digestibility, were 14.5% and 18.5%. Although crude fiber digestibility of these local forages was low for rabbit, the other nutrient digestibility were still high. It is possibly due to the coprophagous function.

(C. W. Liao, C. Z. Huang and Y. S. Cheng)

In vitro assessment of quality improvement of solid-state fermented rice straw by white rot fungi

About 1.5 million tons of rice straw is produced per year in Taiwan. White rot fungi (*Pleurotus eryngii*) possessing of lignocellulase

was selected for the solid-state fermentation for rice straw to improve its feeding value. After sterilized by boiling water, rice straw from

Taichung, Chiayi and Tainan were inoculated with 4% of white rot fungi culture for 4-wk solid-state fermentation. Pesticide residues were decreased with the storage period and boiling treatment. Fermentation even cut down the residue level to 0.31 ppb. Only one rice straw had Fusarium toxins (FB1) detected and became not detectable after fermentation. Cell wall structure of rice straw was observed by the scanning (SEM) and transmission electron microscope (TEM). The closely packed middle lamellae of cell wall of rice straw collapsed and the epidermal structure became loose after fermentation. Rumen availability of rice straw was compared *in situ* by 3 head of rumen-cannulated Holstein dry cows in a 96-hr incubation study. The potentially degradable

fraction of DM, OM, NDF and ADF of fermented rice straw was increased, especially the slowly degradable fraction. However, degradation rate of the slowly degradable fraction was lower. Rumen availability was calculated according to the solid passage rates from 2%/h to 8%/h. Rumen availability of NDF and ADF of fermented rice straw was lower than that of rice straw. This phenomenon might be attributed to the fast utilization of the easily digestible polysaccharides by fungi during fermentation. In summary, solid-state fermentation by white rot fungi could be a proper way to promote the feeding value of rice straw.

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

Screening the heat tolerant *Bacillus coagulans* as probiotic strain from rumen fluid and swine feces

Heat-tolerant *Bacillus coagulans* possess several specific functions including could be stored in room temperature, against high temperature, gastric acid and bile salt and hydrolyze hexose and pentose to generate L-lactic acid. Thus, the heat-tolerant *Bacillus coagulans* may act as a predominant probiotic strain in intestine or as an effective inoculant in solid-state fermentation. The aim of this study is to screen the heat-tolerant *Bacillus coagulans* from swine feces and rumen fluid. Ten candidate

strains of *Bacillus coagulans* were screened from pig feces and rumen fluid. In the sporogenes test, five candidate strains were found to endure 90°C high temperature treatment. From 16S rDNA nucleotide sequence analysis, six strains belonged to the *Bacillus coagulans* family. From the acid and bile salts test, one strain from swine feces could survive (> 80%) under pH 2 acid and 2% bile salts conditions.

(F. C. Liu)

Comparisons of filterbag and soxhlet methods for crude fat content in feed

Crude fat (CF) in feed has been analyzed by filterbag method with higher efficiency and lower extraction solvent. This study adopts CNS soxhlet method as the standard method and evaluate the filterbag method (Ankom^{XT15}) for CF analysis in feed. To set up the 60-min extraction filterbag method, 18 feed was divided into three groups according to their CF content, low (CF < 5%), medium (5 ≤ CF < 10%) and high (CF ≥ 10%). Each group possessed 6 kinds of feed samples. Results showed that the actual difference of CF content between the soxhlet and filterbag method in three ranges were 0.34%, 0.35% and -0.46%, respectively. A total of 88 plant and animal feed were sampled for CF analyses. The actual CF values of corn, soybean

meal, full fat soybean, distiller's dried grains with soluble (DDGS) and copra meal analyzed from filterbag methods were higher than those from soxhlet method by -0.98%, -0.68%, 0.15%, -0.49% and -0.19%. The coefficient of variation (CV) for individual feed between two methods turned out to be 27.3%, 20.2%, 2.1%, 2.3% and 2.2%. Analyses results from filterbag method had much higher deviation for those feed with low CF content. For animal feed, chicken meat meal, fish meal and meat and bone meal, actual value difference between two methods were -0.88%, 0.02% and -0.20%, respectively. The CV reached 6.9%, 3.6% and 2.3%. Comparison results indicated that for feed containing medium to high fat the actual

analyses difference between two methods were lower than 0.5% and also with the much lower CV. Thus, filterbag method was suggested to be

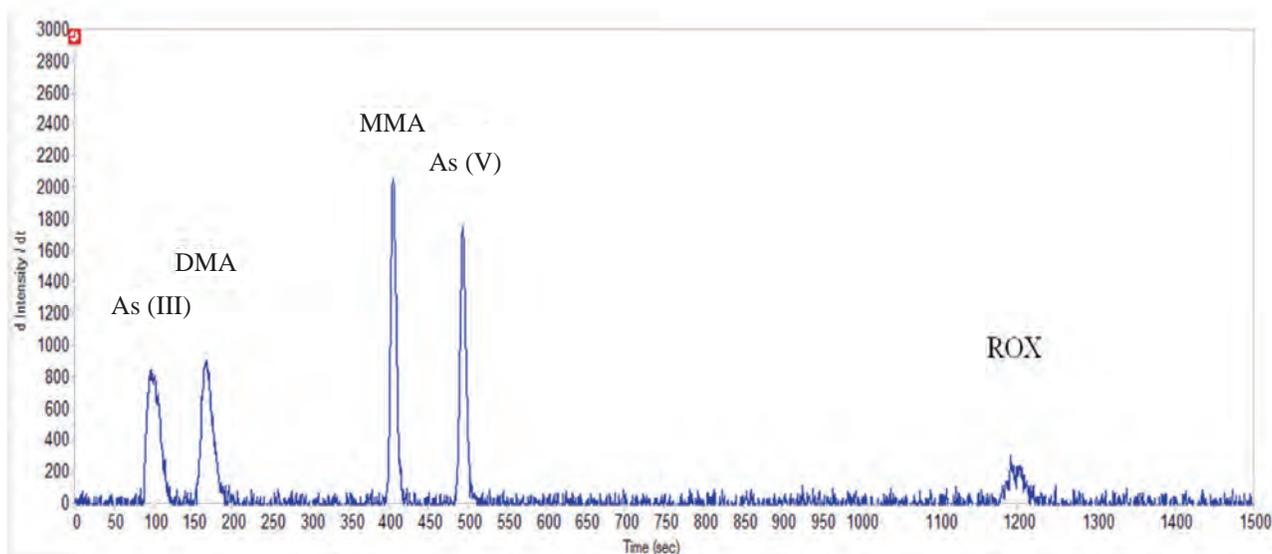
applied for feed containing CF above 5%.
(C. C. Hung)

Establishment of the chromatographic conditions for arsenic speciation by HPLC-ICP/OES

Arsenic is one common element in nature. Its content is an important testing item in feed safety monitoring program because of its strong toxicity and carcinogenic characteristic. The chemical and biological toxicity of arsenic is dependent on its chemical forms. Therefore, the total content of arsenic could not reflect its real influence in feed safety and consumer health. This study tried to establish the optimal chromatographic conditions for arsenic speciation in feed samples by using HPLC-ICP/OES instrument. The results showed with 0.5 L/min nebulizer gas flow and 0.4 L/min auxiliary gas flow rate, the

high detection sensitivity achieved. When provided HPLC a 1.5 mL/min flow rate of 100 mM $(\text{NH}_4)_2\text{HPO}_4$ and a PRP-X100 anion exchange column, retention times for As (III), As (V), MMA (monomethylarsenic acid), DMA (dimethylarsenic acid) and ROX (Roxarsone) were 122, 227, 428, 501 and 1,950 seconds, respectively. To set up calibration curve for five arsenic species, a concentration range from 0.2 to 5 mg/kg was prepared. Coefficient of determination for all five species were all above 0.998.

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



Five species of arsenic

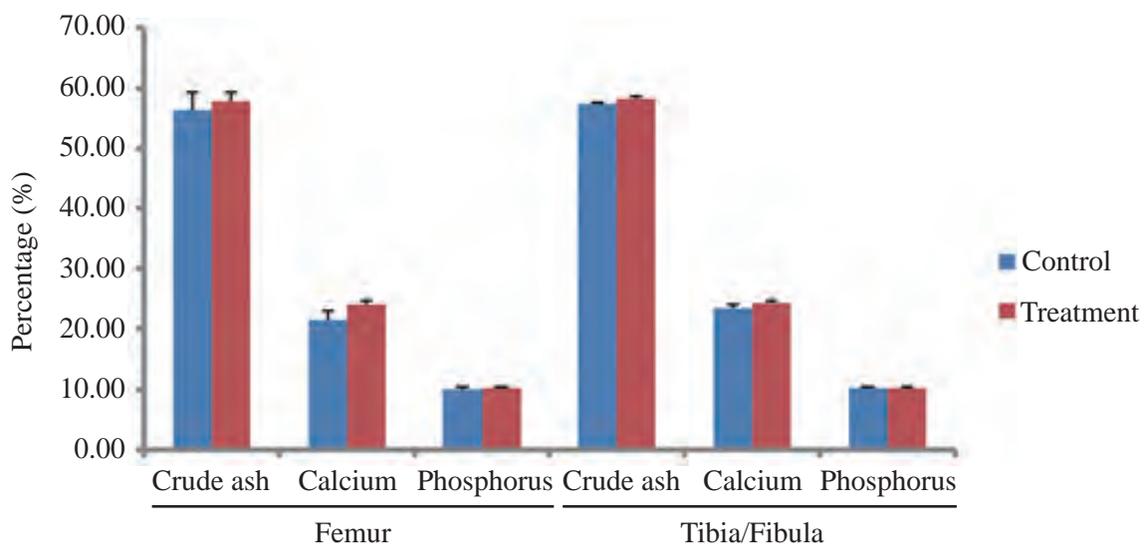
Animal Physiology

Establishment of osteoporosis model and induced pluripotent stem cells in miniature pigs

The purposes of this study were to establish the osteoporosis model in minipig and minipig induced pluripotent stem cells (mpiPS). The osteoporosis in minipig was induced by ovariectomy and low-calcium diet (0.5% calcium) feeding for 6 months. Bone mass density was measured by X-ray scanning and the bone formation/bone resorption indicators in blood were also analyzed. After feeding trial, the crude ash and the concentration of calcium/phosphorus in bone ash were measured. The results showed that the concentration of osteocalcin in treatment groups has the trend to increase, but the level of bone-alkaline phosphatase, tartrate-resistant acid phosphatase 5b, and C-telopeptide of type I collagen do not show significant change. In addition, the bone mass density, crude ash and calcium/phosphorus

level have no significant difference. In mpiPS experiments, the genes of *Oct-4*, *Sox2*, *Klf4* and *c-Myc* were successfully introduced into porcine fibroblasts, and the transfected cells were transformed into colony morphology from spindle morphology. Moreover, the mpiPS cells were positive for the pluripotent markers, including Oct-4, AP, SSEA-3, SSEA-4, TRA-1-60 and TRA-1-81. The embryoid bodies were formed by hanging drop culture with high efficiency, but so far teratoma formation did not observe after transplanted into NOD-SCID mice. The results demonstrated that osteocalcin is significantly different in the induction of osteoporosis in minipigs and the establishment of miPS will apply on biomedical research in the future.

(J. R. Yang and Y. J. Liao)



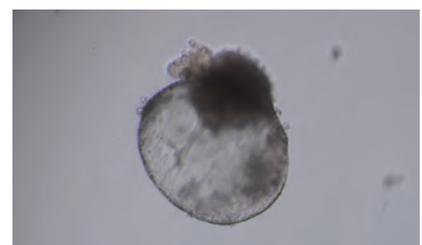
The percentage of crude ash, calcium, phosphorus in femur and tibia/fibula



The morphology of mpiPS colony



The expression of *Oct-4* was positive after immunocytochemical staining



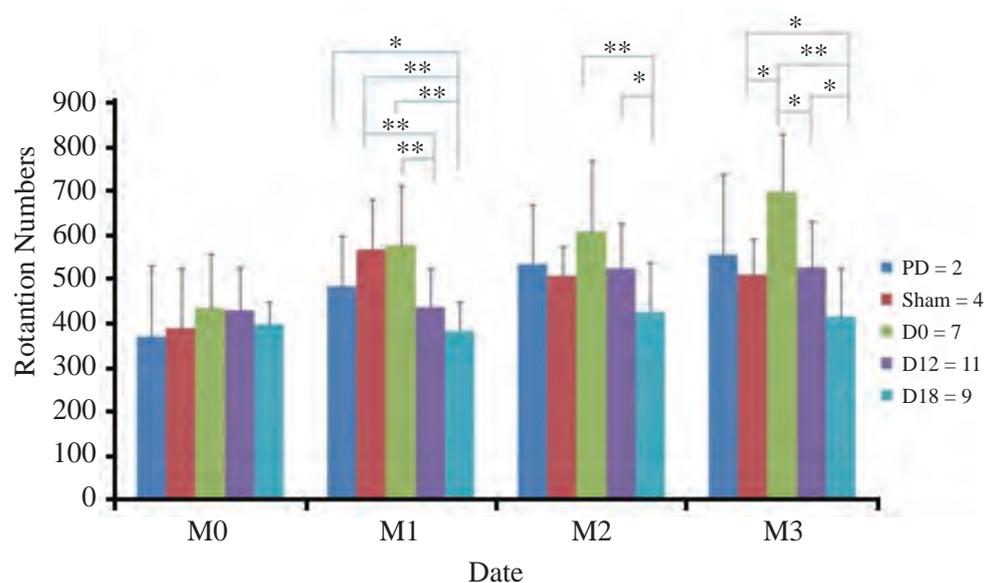
The embryoid body was formed by hanging drop culture

Transplantation study of porcine induced pluripotent stem cells

I. In the animal model of Parkinson's disease

This study focuses on the therapeutic effects of porcine induced pluripotent stem cells expressing green fluorescence protein (piPS/GFP⁺ cells) which had been differentiated into different stages of neuron progenitors and been transplanted to Parkinson's disease (PD) rats. The piPS/GFP⁺ cells with or without neuronal induction were transplanted into the striatum of brain in PD rats with unilateral 6-OHDA lesion. The methamphetamine induced rotation behavior which was evaluated monthly for the therapeutic effect. Our data indicated that the recovery of behavior deficit in PD rats transplanted with the piPS/GFP⁺ cells with two stages of neuronal

induction better than that transplanted with piPS/GFP⁺ cells without neuronal induction or one stage of neuronal induction. The piPS cells after transplantation can be traced by GFP expression and the survival, proliferation, and differentiation of transplanted cells in rat brain were confirmed by NeuN and GFAP staining. Therefore, our results revealed that piPS/GFP⁺ cells after neuronal induction could exhibit good therapeutic effect in PD rats and that provide important information for the clinic treatment of PD patients using iPS cells in the future. (J. R. Yang)

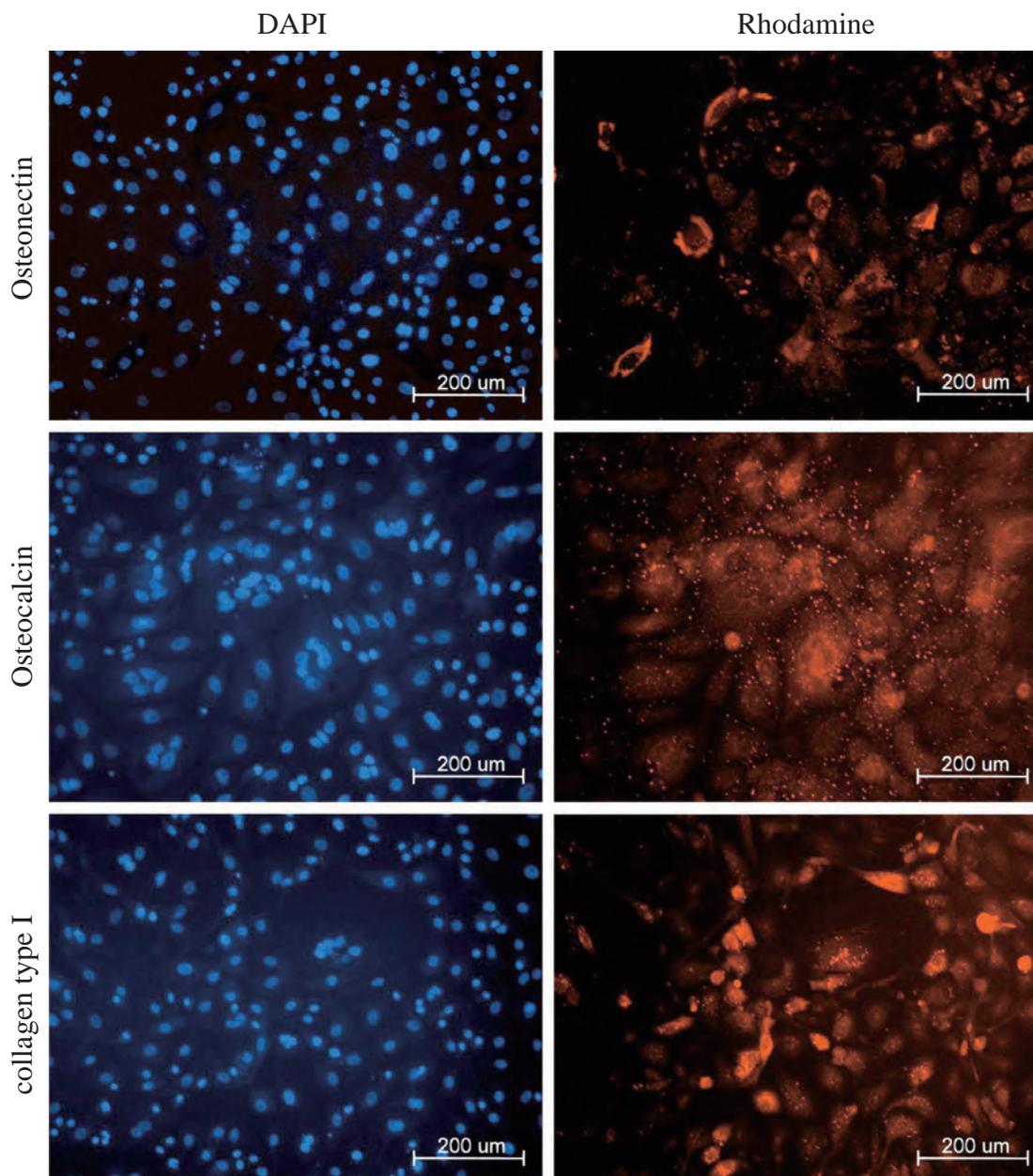


The results of rotation numbers during 3 months in Parkinson's disease rats transplanted with piPS cells with different neuronal differentiation stages

Differentiation of osteoblasts from porcine induced pluripotent stem cells

The aim of this study was to establish osteoblasts from porcine induced pluripotent stem (piPS) cells. After 4 weeks of induction, the differentiated cells were exhibited similar morphology of osteoblast. Calcium-rich deposits were positive by alizarin red S staining, and the expression of osteoblast-related markers such as osteonectin, osteocalcin, and collagen type I were also enhanced after differentiation. The efficiency of expressions was $45.8 \pm 0.1\%$, $24.5 \pm 0.1\%$ and $23.4 \pm 0.2\%$, respectively.

The results support that osteoblasts can be generated from piPS cells cultured in the osteogenic medium we established, and the cells might be beneficial for alternative source of osteoprogenitors for bone tissue engineering. (J. R. Yang and Y. J. Liao)



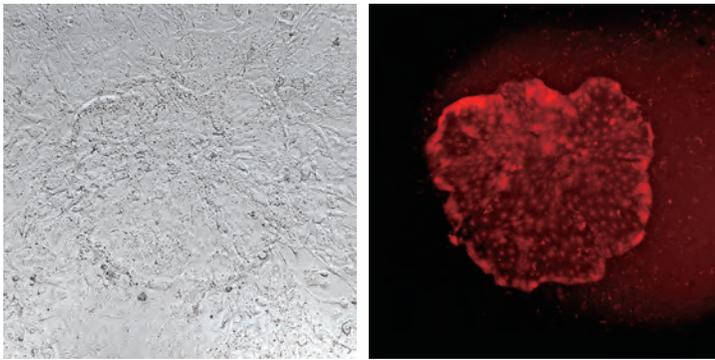
The expression of osteogenic markers in osteoblasts

The inhibition of teratomas formation by shRNA

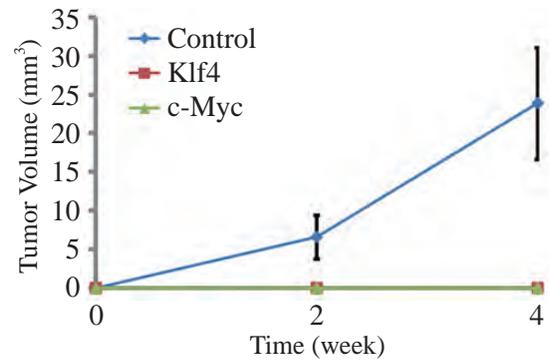
RNA interference (RNAi) is a process in which RNA molecules regulate gene expression, and also as a tool to study the gene function. In present study, we attempted to inhibit the gene expression on kruppel-like factor 4 (Klf4) and Myc (c-Myc) of porcine induced pluripotent stem cells (piPS cells) by short hairpin RNA (shRNA) and to evaluate the teratoma formation. The shRNA-Klf4 or shRNA-c-Myc vectors containing a reporter gene, TagFP635, were transfected into piPS cells by lentivirus transfection. The observed red fluorescence after one week transfection indicated the successful

transfection. Furthermore, the cells transplanted into SCID mice were unable to form teratomas. Thus, the gene expression of *Klf4* and *c-Myc* was essential to maintain the undifferentiated state and promote the teratoma formation. We in the future might use this RNAi technique to remove the undifferentiated piPS cells before cell transplantation to decrease the possibility of teratoma formation.

(Y. J. Liao and J. R. Yang)



The piPS cells expressed infrared fluorescence.
(A) Visible light; (B) Infrared



The formation of teratomas derived from piPS cells

Isolation of goat major semen plasma protein and its effects on sperm quality and fertility after cryopreservation

The aim of this study was to evaluate the Alpine buck semen absence or presence semen plasma and in the absence semen plasma conditions add bodhesin-2 and seminal vesicles protein in the diluent on frozen-thaw spermatozoa quality and the fertilization ability of goats. The results showed semen absence or presence semen plasma and in the absence semen plasma conditions added bodhesin-2 and seminal vesicles protein in the diluent of frozen-thaw spermatozoa motility (62.00 ± 1.71 vs. 62.27 ± 3.00 vs. 75.77 ± 3.02 vs. $74.80\% \pm 2.11$),

viability (86.07 ± 3.94 vs. 88.43 ± 2.63 vs. 86.93 ± 1.56 vs. $87.13\% \pm 1.34$), acrosome integrity (60.03 ± 5.60 vs. 64.80 ± 2.00 vs. 62.37 ± 2.06 vs. $62.47\% \pm 1.80$), mitochondrial potential (75.70 ± 4.64 vs. 79.93 ± 1.88 vs. 74.80 ± 2.59 vs. $75.40\% \pm 0.85$), pregnant at day 45 (40 vs. 36 vs. 80 vs. 78%), lambing rate (60 vs. 60 vs. 87.5 vs. 42.8%) and average litter size (1.71 vs. 1.6 vs. 2.6 vs. 1.3).

(T. C. Kang, Y. H. Chen, F. H. Chu, J. R. Yang and L. R. Chen)

Isolation of major semen plasma protein from goat semen

The aim of this study is to establish the isolation processing of heparin-binding proteins from goat seminal plasma. The caprine semen was centrifuged to remove sperm. The semen plasma proteins were precipitated by cold ethanol. The precipitates were dissolved in ammonium bicarbonate and lyophilized. The lyophilized proteins were dissolved in phosphate buffer and loaded onto a gelatin-agarose column. The column was successively washed with phosphate buffer and then phosphate buffer saline with 0.5 M urea to remove unadsorbed proteins, and the adsorbed proteins were eluted with 5 M urea in phosphate buffer. The protein bands of 14, 15, 20 and 22 kDa were found after SDS-PAGE. The adsorbed protein

fraction was then absorbed by a Heparin-affinity chromatography to separate 20 and 22 kDa proteins from 14 and 15 kDa proteins. The resulted product was analyzed by using the matrix-assisted laser desorption ionization-time of flight mass spectrometry (MALDI-TOF MS) to determine the amino acid sequence and identify the proteins. The aim of this study is to establish the method for isolation and characterization of goat major semen plasma protein. The effects of semen plasma protein removal on sperm quality and fertility after cryopreservation will also be evaluated.

(T. C. Kang, Y. H. Chen, F. H. Chu, J. R. Yang and L. R. Chen)

Studies on caprine arthritis encephalitis monitoring

The objectives of this experiment are to perform CAE virus (CAEV) monitoring in serum and to use a screening method named

“nested polymerase chain reaction” (nested PCR) as a reference for the control of CAE. This survey was conducted from July 2013 to

June 2014 in the eastern part of Taiwan. Serum samples, which taken from goat's jugular vein in every 6 months of age were assayed. In the first stage, the method of Enzyme Linked Immunosorbent Assay (ELISA) was used to analyze the serum samples. In the results, The frequency of positive results in 0-12 months, 13-24 months and above 24 months were 74.3% (84/113), 36.4% (4/11), 0% (0/5), respectively. The frequency of positive results in does and

buck were 70.9% (44/62) and 68.6% (46/67), respectively. There were no correlation between does and buck of goat in the CAE positive results. In the second, the DNAs were extracted from the blood of the 41 ELISA-negative goats and used nested PCR for viral detection. There were showed 2 positive results, and then nested PCR results were confirmed by sequence analysis. (C. C. Chang and S. Y. Wu)

Detection of caprine arthritis encephalitis virus (CAEV) in semen of male goat

Artificial insemination (AI) is essential to improve animal production performance. Although it greatly reduces the risk of pathogen transmission, some studies have been performed to quantify this risk. The aim of this experiment are to perform Caprine arthritis encephalitis virus (CAEV) monitoring in semen and to use a screening method named nested polymerase chain reaction (nested PCR) as a reference for the control of CAE. Blood samples of eight Nubian goats from a Taitung goat farm were used for test. The collected serum were evaluated for anti CAEV antibodies using a commercially available ELISA kit (Chekit ® CAEV/MVV, Liebefeld Bern, Switzerland). The DNAs were extracted from the blood and semen and used nested PCR for viral detection. Semen samples

were collected and separated into three distinct fractions: seminal fluid (SF), enriched non spermatozoa cell (NSC) and spermatozoa (SPZ). Nested PCR was used to detect the presence of CAEV proviral DNA in the blood and semen. Five CAEV seropositive bucks were positive for nested PCR CAEV proviral DNA but only three semen samples were positive for CAEV DNA in non-spermatic cells and seminal plasma. No CAEV proviral DNA was identified in the spermatozoa fraction. The presence of CAEV proviral DNA in non spermatic cells and seminal plasma. This study clearly demonstrates the presence of proviral DNA in naturally infected male goat semen.

(C. C. Chang and S. Y. Wu)

Improvement on production of minimal disease minipig

Laboratory animals play important role in development on medical research and biotechnical industry. The aim of this project

is to supply high hygienic and genetic quality minipigs graded in minimal disease, MD, as laboratory animals by upgrading facilities, monitoring specific pathogen periodically, improving the standard operation procedures and promoting animal welfare. The new boar facility was rebuilt in 2014 to promote breeding management and occupation safety on boar semen collection with a well-designed preparation room in which the working space is lower than ground level to allow technician contact the animal in safe way. For promoting the extension service quality and being responsible for our animals, the QR code is introduced to the animal certificate which can be read by portable device such as cell phone and tablet. Users can get the animal identification and track the management records more



Providing certificate with Q R code

quickly and conveniently. And the site visit for reassessing animal care program from AAALAC International was also well prepared in October

2015.
(H. P. Chu and M. S. Huang)



The reassessment of AAALAC International accreditation in October 2015

Promoting industrialization of laboratory miniature pig and constructing knowledge services platform

For the purpose of speeding up the industrialization on laboratory miniature pigs to be the critical part of the biotechnology industry, this project is going to keep improving the facilities and animal care programs to maintain the AAALAC accredited status and to develop value added services on products, technology and information by fortifying knowledge base,

technical documents and sharing interface that help to create friendly supply system for biomedical users and therefore it will promote the demands of biomedical research and biotechnical industry that may contribute to attract the civil investment and to accelerated industrialization.

(H. P. Chu)



AAALAC accreditation renewal review



The national laboratory animal center of exchange of visits

Establishment of artificial insemination in Elk cross red deer

The aim of this study was to evaluate the effect of different timed to artificial insemination in elk x red deer. Two sexually matured males were used for semen collection. Only the semen collected by electro-ejaculation with a sperm motility score (SMS) ≥ 4 and survival rate $\geq 80\%$ was used. Fresh semen was conducted to cryopreservation in TES extender containing yolk. Thereafter, the semen was packaged into 0.5 ml straws (1×10^8 spermatozoa/ml). The

hinds were artificially inseminated once at 48, 54, 60 or 72 h after CIDR removal. The results showed the pregnant rates of 48 h (50.0%), 54 h (55.0%) and 60 h (58.3%) were higher than 72 h (20.0%) after CIDR removal. In conclusion, the hinds which carry out artificial insemination at 48 h to 60 h after CIDR removal have a better pregnant rate.

(H. H. Lin, S. R. Kang, K. J. Liang, C. H. Wang, C. Y. Lin, P. C. Shen and S. S. Liu)

Improvement on pig spermato-cryopreservation: influence of protein composition on cryo-resistance of pig spermatozoa

In this study, porcine *in vitro* culture systems assessed before and after cryopreservation of porcine semen heat shock proteins, the impact on the efficiency of *in vitro* fertilization pig. Discussion frozen heat shock proteins cause structural and functional changes affecting the pig sperm fertilizing capacity. Collection six head boar semen sexually mature, measured survival, vigor and concentration of fresh sperm. Semen samples were subjected to freeze-thaw sperm viability and vitality was detected. With fresh semen 20% egg yolk and add 9% LDL be frozen by freezing dilution, to assess its viability after thawing. And the use of RIPA buffer collect sperm protein extract, then enzyme-linked immunosorbent assay (ELISA, enzyme-linked immunoadsorbent assay) test analysis sperm HSP60, HSP70, SHP90 content before and after freezing. Test results showed that the average survival of 1-6 before freezing of boar semen from 72.12 to 89.21%; extraction with 20% dilution of the egg yolk thawed frozen sperm protein in an amount of 386 $\mu\text{g}/\text{mL}$ and 593 $\mu\text{g}/\text{mL}$ and an amount of 9% LDL diluent are thawed frozen

sperm protein was 405 $\mu\text{g} / \text{mL}$ to 639 $\mu\text{g} / \text{mL}$. 6 frozen boar semen dilution add 20% egg yolk and freeze-average survival rate after thawing of the 31.95 to 48.12%, 9% and freeze-thaw after the average survival was 39.65 to 56.97%). The use of SDS-PAGE electrophoresis analysis of protein samples before and after freezing the sperm of the state, show the level of post-thaw sperm viability and HSP60, 70 and 90 content level of a correlation between higher post-thaw sperm viability after their ELISA interpretation of their data have higher phenomena situation. However, in this trial of boar semen six are 20% and 9% LDL yolk dilution in frozen sperm after thawing survival rate to 9% LDL treatment higher than 20% yolk phenomenon but there is no difference. HSP protein in comparison between the treatment groups in the higher survival rate of their situation have a higher content of HSP. Also in the freeze-*in vitro* fertilization after thawing average fertilization rate of 20% yolk of 14.73 to 38.5% and in 9% LDL of 19.7 to 44.65%.

(Y. H. Chen, T. C. Kang, F. H. Chu and L. R. Chen)

Effect of age on the quality of semen of Formosan sambar deer

The aim of this study was to evaluate the effect of age on the quality of semen of Formosan sambar deer. The semen was collected by electro-ejaculation during the favourable reproductive season (from July to October). Then, stags were divided into two groups by age: 2-4 years old (11) and 5-9 years old (12) for further evaluation of the semen traits.

Results showed that the semen volume, sperm motility score (SMS), sperm concentration, total sperm, sperm viability (VIAB) and abnormal morphology of 2-4 year-old Formosan sambar stag semen collected by electro-ejaculation were 1.1 mL, 4.5, 16.4×10^8 sperms/mL, 15.3×10^8 sperms/mL, 81.3% and 13.7%, respectively. In the 5-9 year-old group, semen volume, sperm

motility score (SMS), sperm concentration, total sperm, sperm viability (VIAB) were 4.7, 14.3×10^8 sperm/mL, 1.97 billion, 82.2%, 81.3% and 14.1%, respectively. There were no significant difference on the quality of semen

when compared under the same conditions. In conclusion, the age will not affect the semen traits of Formosan sambar stag.

(*H. H. Lin, K. J. Liang, S. R. Kang, C. Y. Lin, C. H. Wang, P. C. Shen and S. S. Liu*)

Improvement of Taiwan's dairy bull semen-collecting and freezing operations

Production of dairy bull frozen semen and sorted frozen semen are extremely important artificial reproductive technologies for cows breeding, and bull semen-collecting technology is the most critical upstream technology. Livestock Research Institute, Council of Agriculture, the team with the kind of livestock and poultry program, established welfare breeding and humanitarian semen-collecting technology including dairy bull breeding barn area with moving lines, fences and security entrance design and animal traction and fixation. We had build Taiwan's dairy bull semen-collecting standardized operations, based on the animal welfare and personnel safe manner

and provides fresh, vibrant quality semen for producing dairy bull frozen semen and sorted frozen semen. The results showed good quality (such as sperm count, sperm mobility, vitality) of semen, collected from April 2013 to September 2014 and indicated the quality of fresh collected semen is not affected by the summer heat. The ejaculation volume could reach 12 ml and spermatozoa concentration could up to 1.99×10^9 spermatozoa per ml. We used yolk and LDL extenders and glycerol cryoprotective agent to freeze bull semen, and got good post-thaw survival.

(*J. S. Chao, F. C. Hsiao, K. H. Lee, I. H. Chen, T. F. Shiao, L. R. Chen, M. C. Wu and C. L. Chang*)

A DNA vector system for MMTV-promoter-based, doxycycline-inducible transgene expression and verified by expressing Mst4 gene

A simplified tetracycline-on (Tet-on) system including all the required regulating elements was constructed in a single vector (poMRTneo/GFP plasmid). The single vector contains a Tet-controlled transactivator gene, rtTA2s-M2, a glucocorticoid-responsive mouse mammary tumor virus (MMTV) promoter, a green fluorescent protein (GFP) reporter gene under the control of Tet operator sequences (tetO) flanked with a minimal CMV promoter (TetCMV-min) and a mammalian selection marker neomycin resistant gene. When tested in NMuMG, a mouse mammary epithelial cell line, the expression of GFP was low without treatment and could be efficiently elevated with treatment of doxycycline (Dox, a Tet analogue). Importantly, MMTV-promoter-based Tet-on inducible vectors enabled the transgene not only to express in a mouse mammary cell line, but also be tightly regulated under the simultaneous

treatment with Dox and dexamethasone (Dex, a glucocorticoid analogue), when culture media without steroid. Next, in order to verify the construction strategy is correct, we replaced GFP with Mst4 gene, a sterile 20-like kinase, including a full length wild-type cDNA form and two c-terminus deletion mutants in this inducible system (plasmids poMRTneo/HA-Mst4, poMRTneo/HA-Mst4 Δ 272, poMRTneo/HA-Mst4 Δ 297, poMRTneo/GFP-Mst4, poMRTneo/GFP-Mst4 Δ 272 and poMRTneo/GFP-Mst4 Δ 297). The resulting vector could display the Mst4 expression with lower basal level, higher inducibility and its nucleocytoplasmic dissection. These data demonstrated that we have created a MMTV-promoter-based, doxycycline-inducible transgene system and the simple system is suitable for expressing foreign gene in mammary cells.

(*J. S. Chao*)

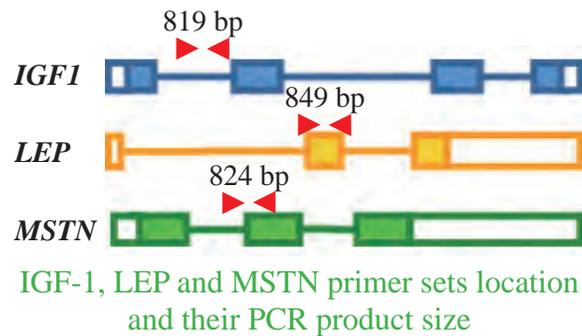
Elucidating the growth performances genes in Taiwan water buffaloes

In this study, we were focused on the relationship of growth performances and target

gene polymorphism on Taiwan water buffalo. IGF-1, LEP and MSTN were well-known growth factors which could influence the growth performance on domestic animals. In order to figured out the relationships among genes, protein concentrations and growth performances, the DNA sequences of target genes were analyzed and the concentrations of IGF-1, LEP and MSTN in serum were determined. The results showed that base alters happened on both IGF-1 and LEP DNA fragments in individual animal. Moreover, the base alters on LEP DNA sequence related to the body weight gain in calves. The concentration of Leptin were significant different among the different growth status herds. The concentration of IGF-1 was

positive correlated to the yearly body weight gain of cattle or heifer cows. Hopefully, we will facilitate the goal of breeding and conservation on Taiwan buffalo by this information in the near future.

(C. J. Hsieh and A. K. Su)



Hatching and rearing in another place for genetic resources conservation in geese

The purpose of this study was conducted a project which hatched the rare species of goose eggs and reared them in another place for genetic resources conservation. One small incubator which had a backup power supplying system was constructed for hatching the eggs. Meanwhile, a brooding equipment had also set up for brooding these goslings. Furthermore, a greenhouse had been constructed for shading, sewerage system and protecting these goslings away from bird and dog when reared those geese. A total of 162 goslings from 4 batches, which came from 123 embryos and 359 cold-storage eggs, had been hatched. During rearing period, a total of 9 geese were dead. One gosling was natural death, and the rest of them were been sacrificed for surveillance. Amount of 153 breeding geese are rearing up to reproduction period. The body weight of White Roman geese at 14 and 20 weeks of age were 5.35 ± 0.52 kg (n = 21) in male and 4.96 ± 0.73 kg (n = 17) in female and were 5.52 ± 0.57 kg (n = 21)

and 5.26 ± 0.73 kg (n = 16), respectively. The body weight of Beidou White geese at 14 and 20 weeks of age were 5.44 ± 0.52 kg (n = 16) in male and 4.84 ± 0.53 kg (n = 23) in female; and were 5.74 ± 0.61 kg (n = 16) and 5.06 ± 0.64 kg (n = 23), respectively. Furthermore, the body weight of White Chinese geese, at 16 and 20 weeks of age were 5.20 ± 0.51 kg (n = 34) in male and 4.37 ± 0.36 kg (n = 17) in female and were 5.37 ± 0.51 kg (n = 34) and 4.54 ± 0.31 kg (n = 17), respectively. The body weight of Brown Chinese geese at 16 and 20 weeks of age were 4.67 ± 0.30 kg (n = 11) in male and 4.03 ± 0.30 kg (n = 18) in female; and were 4.83 ± 0.22 kg (n = 11) and 4.19 ± 0.29 kg (n = 18), respectively. During the rearing period, samples of throat swab, cloaca swab and blood from these geese had been examined eight times. Results showed that surveillance of avian influenza virus in samples throughout these 8 times were negative.

(S. D. Wang)

Reinforcement of production and quality of minimal disease breeding geese

This study is to establish standards of disease prevention and surveillance systems for minimum pathogenic breeding geese to enhance the quality of hatching eggs and goslings. The 3-5 weeks old goslings susceptible

to infection parvovirus, one week old gosling mortality rate of more than 90%, making the industry suffered a major losses. Therefore, the establishment of independent defense system to clear the disease is the highest expectation

for industry. The regular disease screening of geese was completed. The results of detection for all sampled geese on parvovirus, poultry cholera, laying reduction syndrome, Newcastle disease and avian influenza were negative. One hundred and fifty five geese embryonated eggs and one hundred and ten goslings were provided to Taiwan Biological Agents Corporation for preliminary trials on goose parvovirus(GPV)

vaccine. The results for the vaccine antibody titer up to 10^5 EID₅₀/ml, has exceeded the national standard 10^3 EID₅₀/ml, it can be used as a vaccine, but its value is not as good as duck embryo of 10^7 EID₅₀/ml. To enhance the goose-derived vaccine production, we will research how to improve antibody titer of vaccine.

(S. H. Chuang, S. W. Wu, M. C. Lin, S. C. Chang and Y. S. Jea)

Set up a business production model for biomedical geese

The first quarter of disease screening of geese was completed. The results of detection for all sampled geese on parvovirus, Newcastle disease, laying reduction syndrome, duck virus hepatitis, infectious bursal disease and avian influenza were negative. This year has been extended with 60 geese embryonated eggs. The minimal disease goose house acquires ISO 9001: 2008 international quality certification, the

certificate registration number is 15QMA31071. Because of avian influenza disease, all of the geese were sacrificed. And then the facilities of the empty goose house were increased. We keep the empty house under avian influenza virus free condition using swap method.

(S. H. Chuang, C. M. Wang, S. D. Wang, C. L. Hu and T. Y. Lin)

The use of flow cytometry sorting sperm sex

Generally, livestock animals have special gender specific preference. The sex of mammalian offspring can be predetermined by flow-sorting to separate X- and Y-chromosome-bearing sperm. This method is based on precise staining sperm DNA with the nucleic acid-specific fluorophore, Hoechst 33342, to differentiate the subpopulations of X- and Y-sperm. The stained sperm are then sex-sorted using a specialized high speed sorter and collected into biologically supportive media prior to reconcentration and cryopreservation in numbers adequate for artificial insemination or

in vitro fertilization. Sperm sorting can provide subpopulations of X- or Y-bearing sperm at the rate of more than 6,000 sperm/sec with a purity of 85% and has been commercially applied to cattle industry. The sex of offspring has been predetermined in a wide variety of mammalian species including cattle, swine, goats and water-buffalo by using flow cytometric sorting of X- and Y-sperm. After flow cytometry sorting of single-sex sperm survival ratio of more than 60 percent, with the ability to fertilize.

(F. H. Chu)

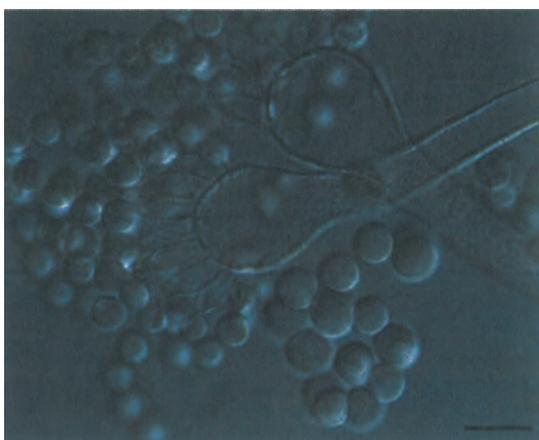
Processing of Animal Products

The physicochemical variations during the processing of salted ham

This experiment was conducted to investigate the physicochemical variations during the salted stage of pork leg (each sample about 2 kg) because the salted stage was often considered as an important process on whole duration of ham processing. Water content, salt content, water activity, pH value, VBN, NaNO_2 were determined every week (D0 to D28) in the pickled stage. The results showed that the water content and water activity were both reducing to 56.8% and 0.903 respectively at D14. The salt contents of sample inside and outside the ham were balancing at D14 (5.1% and 4.9%). The

pH value was about 5.7 to 5.8 before D21 but it was increasing to 5.92 at D28. The VBN value was increasing to 24.0 mg/100 g at D21 and the nitrite residual content was 31ppm after D14. The NaNO_2 content was decreasing after D14, the water activity was still not low enough. That could result in losing the ability to inhibit the microorganism growth. In conclusion, the meat need to drop water activity quickly by drying processing, to make sure the product safety and extend the salted period.

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



The appearance of *Aspergillus oryzae*



The appearance of salted koji and dry koji

Analyzing the nitrogen content during aging period of dry-cured ham

This experiment was conducted to analyzing the nitrogen contents of dry-cured ham during the aging period, such as total

nitrogen (TN), soluble nitrogen (SN), water soluble nitrogen (WSN), non-protein nitrogen (NPN) and free amino acid (FAA). The results



The cross-section of dry-cured ham at 6 weeks



The *Aspergillus oryzae* was incubated onto the surface of ham

showed that the SN, WSN, NPN increased from 10.22 mg/g, 10.84 mg/g and 7.60 mg/g to 19.64 mg/g, 22.63 mg/g and 20.68 mg/g respectively. Proteolytic index (non-protein nitrogen accounting for total nitrogen) increased from 16.57% (W2) to 40.03% (W16). The FAA also increased from 846.8 mg/100 g (initial) to 7,003.3 mg/100 g (W12) and the ratio arrived to 8.1 times. In conclusion, although the proteolytic

index had exceeded than other reports and FAA were still increasing, the different of animal species and processing conditions could influence the variation of the ratio. In addition, the SN was hydrolyzed to NPN during the aging period and probably the variation of SN/TN, NPN/TN index could further analyze continually.

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

Analyzing the physical properties of mixing different colloid

This experiment was conducted to investigate the physical properties of mixing different colloid such as sodium alginate, carrageenan and xanthan gum. The results showed that after high temperature and pressure processing, the carrageenan could improve the hardness value. The max hardness value was found in 75% carrageenan and 25% sodium alginate group (2.71 kg). Carrageenan could not improve the adhesiveness value. The higher adhesiveness values were 25% carrageenan

groups (0.50 kg. sec and 0.41 kg. sec). The texture of xanthan gum was soft and loose, this way could cause the adhesiveness values instability. In conclusion, adding carrageenan could improve the hardness and the sodium alginate and xanthan gum could use to adjust the adhesiveness. Judging from the sensory evaluation, mixing gums could make better colloid texture than single one and appeared the better thermal stability.

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



The canning of the pet canned



The cans of chicken (first row) and turkey (second row) after high temperature and pressure processing

Development and research of the fermented beverage containing chicken egg with lactic acid bacteria

The objective of this study was to develop a novel fermented beverage with whole egg. The products were processed that recombined milk and whole egg were mixed by various ration, and then sterilized, inoculated and fermented at 42-45°C. Results showed that the pH value of control (matrix was only recombined milk, no whole egg) descended down to 3.51 during 24 hours period of fermentation, and its acidity rose up to 1.52%. The pH values of 10-90% whole egg adding treatments were 4.1-4.4 and



A novel fermented beverage containing chicken egg

their acidity were increasing gently (0.87-1.18%). The pH value of 100% whole egg adding treatment rose up to 6.03 and its acidity was sharply descended down to 0.64%. pH values of whole egg adding treatments were not significant difference except 100% whole egg adding treatment. The colonies of lactic acid bacteria were up to 10^8 after fermentation for 12 and

24 hours. On the panel test results showed that 50-70% whole egg adding treatments were the best, their adhesive forces were higher than those of 10-40% whole egg adding treatments. The off-flavor would appear out and acceptance went down when added whole egg over 70% or fermented over 12 hours.

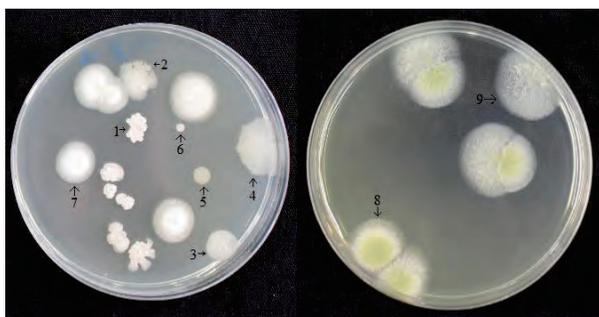
(Y. C. Chen, R. J. Tu and Y. C. Liu)

Microbial species purification and identification of the Douchi and that in fermented salted duck egg white (sufu-like product) process

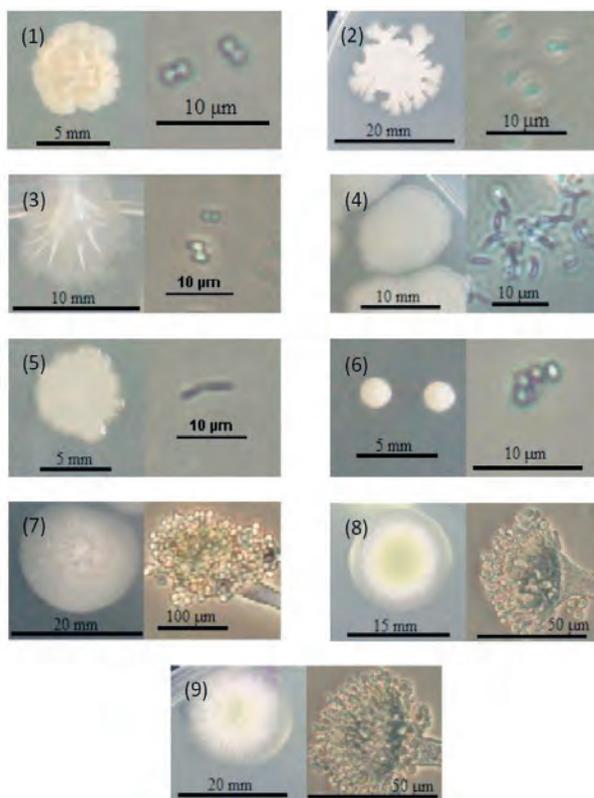
Salted duck egg white (SDEW) was the by-product of salted duck egg manufacture. It was usually discarded because of its high concentration of NaCl. In 2012, LRI had successfully developed a sufu-like product by using SDEW directly. That can fully utilize protein resource. The objective of this study was to identify the microbial species in the douche and that in fermented salted duck egg white process by the gene cloning method. Results showed that indouchi there were 9 types of colonies with different morphological characteristics which included bacterium of *Bacillus amyloliquefaciens*, *Bacillus licheniformis*, *Bacillus methylotrophicus*, *Bacillus subtilis*, *Enterococcus* sp. etc. and fungus of *Aspergillus oryzae* and *Aspergillus terreus*. In fermented SDEW product process, it was found *Bacillus* also dominated in douchi (88.9%) and would reduce to 51.0% in the semi-finished product. In the final product, *Bacillus* returned to dominate and was up to 76.6%. *A. oryzae* was

the dominant fungus detected in douchi and only fungi detected in the final product, in which *A. oryzae* RIB40 was up to 92% ration of fungus. It revealed the relative abundance of the microorganisms might be changed during the processing but *Bacillus* and *A. oryzae* still dominated.

(Y. C. Chen, Y. S. Liao, F. J. Tan and R. B. Liaw)



Douchi samples incubated on the plate count agar (PCA) and potato dextrose agar (PDA) at 35°C for 3 days (left: PCA; right: PDA)



Morphology and micrograph observation of microorganisms isolated from douchi. (1)-(9) were corresponding with the colonies incubated on PCA and PDA

Development and research of the dried egg white snack products

The experiment was conducted to study the effects of different processing procedures

on dried chicken egg white snack food. Chicken egg white was homogenized and heated in

the mold, then that was processed through cutting, soaking (seasoning), frying and drying procedures and the dried chicken egg white was prepared. There were 4 treatments (A-D) in this experiment using various combinations of procedures. The procedure of A treatment was soaking only, of B treatment was soaking and drying, of C treatment was full steps (soaking, frying and drying) and of D treatment was frying and drying. The result showed that A treatment had the highest yield (96.05%). Also, the yields of B treatment and C treatment were almost (64.62% vs. 61.27%). It showed that the marinade adding could cover the weight loss which was due to frying procedure. However, it would cause the yield low down to 60% without soaking process (D treatment). Hence, drying process was the key step for the yield. On

physical-chemical analysis hand, the protein, salt contents and hardness, hardness work increased with procedures increasing but moisture and yield decreased. The water activities of all treatments were between 0.94 and 0.99. In the sensory evaluation, the acceptability of C treatment was the lowest in all treatments because of its low moisture and high salty taste. Both textures of B and C treatments products were similar, but B treatment product got a best score owing to the salty taste being less than that of C treatment. The product of A treatment got a better acceptability but the high moisture content would influence its shelf-life. Although the texture of product of D treatment was good, it still didn't get a better taste yet.

(Y. C. Chen, Y. C. Liu and R. J. Tu)



A novel dried chicken egg white product (vacuumed pack)



A novel dried chicken egg white product

Chemical composition and protein in extracts analysis of velvet antler of Formosan sambar deer and New Zealand's red deer

Velvet antler (VA) is one of the most valuable Chinese traditional medicines and commercial functional foods with enhancing vital energy and immune system. The industry output of VA from Formosan sambar deer is more than 80% in Taiwan deer industry. New Zealand is the only one country that VA input. The purpose of this study was to compare the components of VA from Formosan sambar deer and New Zealand's red deer. The results show that VA from Formosan sambar deer had higher yield rate after heat drying or freeze-drying process than New Zealand's red deer, 34.62-39.51% vs. 29.62-35.28%. VA from New Zealand's red deer had higher moisture content (65.86-68.18%) and crude protein content (19.64-21.55%). VA from Formosan

sambar deer had higher collagen content (94.68-110.38 mg/g), ash content (15.99-18.72%) and crude fat content (1.06-1.65%). To take



Velvet antler of New Zealand's red deer

quantitative VA powder for water extraction or alcoholic extraction, the water extracts of SDS-PAGE electrophoresis showed more of the protein profile than alcoholic extracts (4-6 vs. 1-3). From this, the protein of VA had slightly

different between Formosan sambar deer and New Zealand's Red Deer.

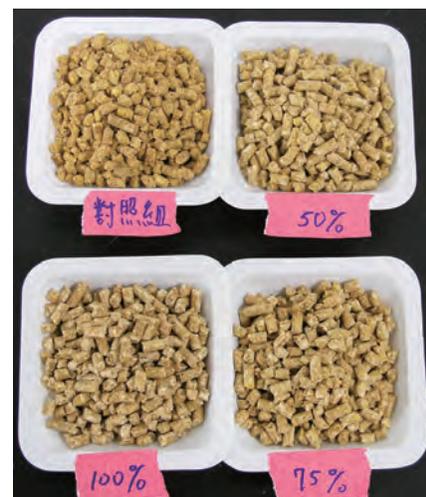
(C. Y. Kuo, P. M. Chen, J. S. Wang, H. L. Ciou and M. J. Chen)

Evaluation of the effect of substitution of corn by brown rice in diets on the growth performance and carcass quality of growing-finishing LD pigs

A total of 50 LD (Landrace × Duroc-Jersey) crossbred pigs with averaged body weight (BW) of 30 kg were used. Pigs were allocated into 5 treatments by BW and fed with five diets, i.e. control, graded levels substitution of corn (SC) in the control diet by brown rice (SC 50%, SC 75%, SC 100% and SC 100% with iron-amino acid). Feed and water were provided *ad libitum*. Pigs were fed the finisher diets when the average BW reached 65 kg. When BW reached 120 kg, all pigs were weighed and six pigs from each treatment were delivered to the slaughterhouse and the carcass characteristics were measured. The growth performance, carcass quality, meat composition, panel test of loin meat and fatty acid composition of the meat were evaluated. The results showed the pigs fed a diet of SC 50% had more efficient utilization of feed during the growing period. The pigs of SC 50% had less backfat thickness and higher marbling in the loin meat. The overall acceptability of loin from pigs fed the SC 50% did not differ from

the control group, but was higher than the other groups. No difference was observed on the fatty acid composition of loin meat among groups. Substitution of corn by brown rice in the diet of growing-finishing pigs to 50% is recommended.

(C. W. Liao, B. L. Shih, G. J. Fan, T. C. Yang, H. F. Lee, W. S. Chen, M. H. Lai and C. F. Lee)



Graded levels substitution of corn by brown rice



Brown rice



LD crossbred pigs

Studies of the meat quality and composition of extract from turkey and quail

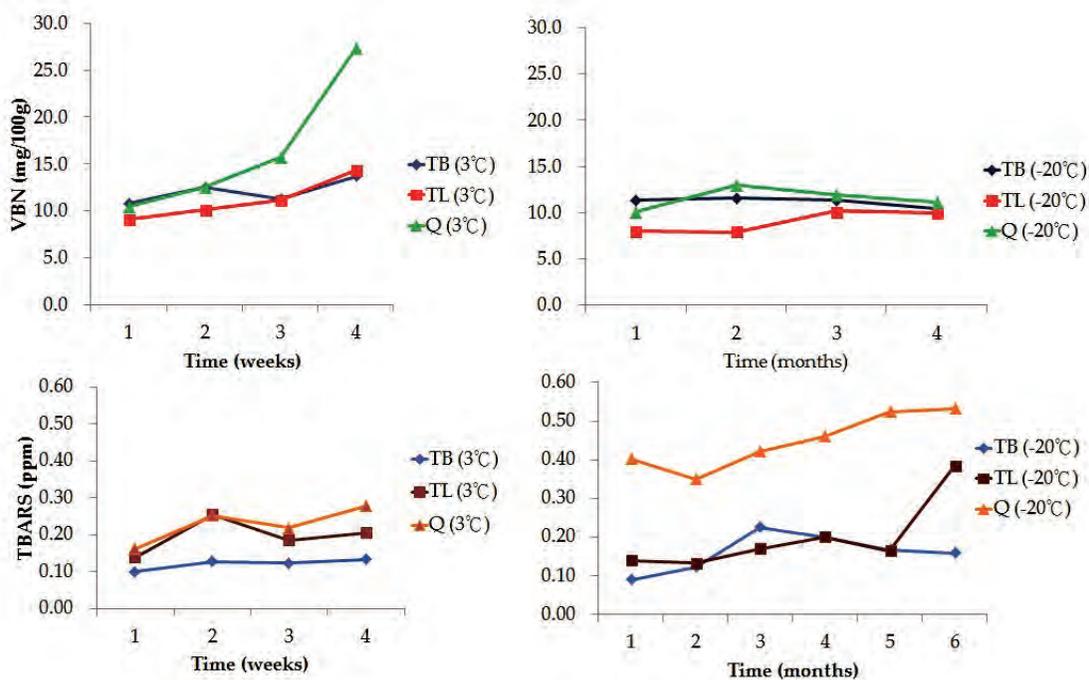
This study was conducted to evaluate the effects of chilled (3°C for 4 weeks) and frozen

(-20°C for 6 month) conditions on chemical composition, color (L*, a*, b* values), water

holding capacity (WHC, tested by free water contents), cooking loss, shear value, total plate counts, volatile basic nitrogen (VBN) and 2-thiobarbituric acid reactive substance (TBARS) of the local turkey breast (TB), turkey thigh (TL) and quail meats (Q). The results showed that the crude fat, crude protein, moisture and ash contents of turkey meats were 1.1-4.2%, 18.5-23.3%, 74.1-75.9% and 1.0-1.4%. On the other hands, the crude fat, crude protein, moisture and ash contents of quail meats were 2.2-3.2%, 20.1-22.5%, 73.7-75.9% and 1.0-1.5%. Shear values of three types of meats, cooking loss, L* and b* values of quail meats in frozen condition were significantly high than those in chilled condition during the storage time. However, there were no significant differences in cooking loss (TB and TL), pH values (TB and TL) and meat color (TB) whether the chilled or frozen conditions. The WHC of quail meats was higher because that there were no free water detected during

the chilled or frozen storage time, expect the 2nd and 5th month in the frozen condition. The results also showed that total plate counts of all samples stored at -20°C were fit the Taiwanese hygiene standard. But, total plate counts of the turkey thigh meat stored at 3°C within two weeks and the turkey breast and quail meat stored at 3°C within three weeks were over 5 log CFU/g. Moreover, the VBN of turkey breast and quail meat stored at 3°C were over 11.0 mg/100g within two weeks. However, the VBN values of turkey thigh meat stored at 3°C for three and four weeks and stored at -20°C for six months were 11.2, 14.4 and 15.5 mg/100 g, respectively. During the storage period, TBARS values of all quail meat samples were increasing slightly with the prolongation of time, but there was no significantly different in the TBARS value of turkey breast meat between the different storage temperatures.

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



Results of preservation tests in turkey breast meat (TB), turkey thigh meat (TL) and quail carcass (Q) during the storage

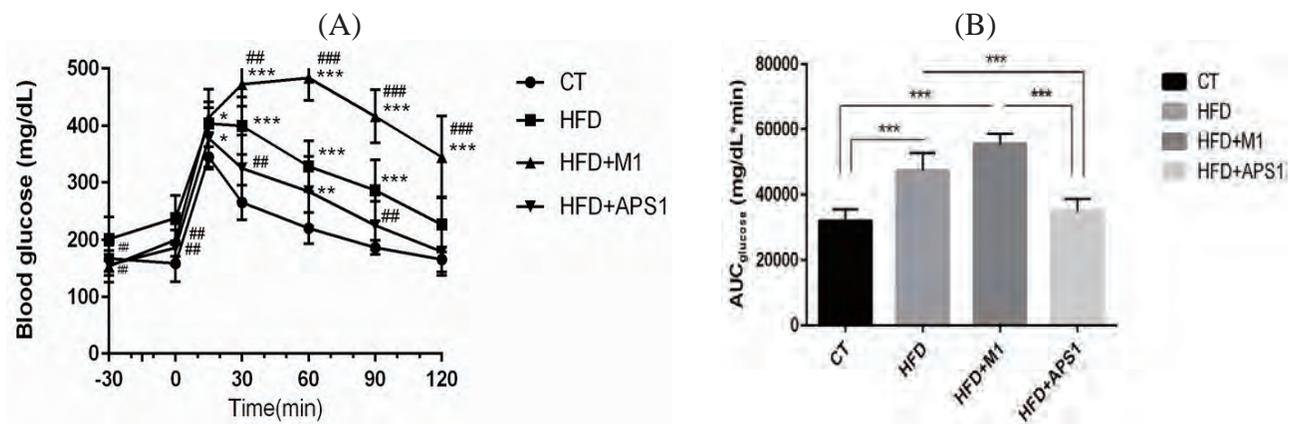
Effect of *Lactobacillus mali* APS1 on homeostasis in diet-induced obese mice (2014)

Obesity was associated with several metabolic disorders, such as Type 2 diabetes (T2DM), insulin resistance and cardiovascular

disease. In previously works, several potential probiotic strains including *Lactobacillus* (*Lb.*) *mali* APS1 from sugary kefir have been isolated.

Alterations of metabolic syndrome by probiotic administration are widely acknowledged affecting host health, Thus, the purpose of this study is to investigate the effect of potential probiotic strain *Lb. mali* APS1 on the regulating glucose homeostasis using high-fat diet induced animal models. The results indicated that the group of *Lb. mali* APS1 showed

significantly higher GLP-1 concentration (40.08 ± 8.83 pg/mL) and lower insulin secretion than positive control. Furthermore, *Lb. mali* APS1 in oral glucose tolerance test (OGTT) and area under curve (AUC) test also showed better functional properties on glucose homeostasis. (Y. C. Lin and M. J. Chen)



Effect of *Lb. mali* on (A) oral glucose tolerance test, (B) area under the curve for the glucose tolerance test in HFD-induced obesity mice at the 8th week.

*P < 0.05, **p < 0.01, ***P < 0.001 compared with CT.

#P < 0.05, ##p < 0.01, ###P < 0.001 compared with HFD.

Study on the growth performance, carcass characteristics and processing methods of chinese geese and chinese hybrid geese

This study was conducted to investigate the effects of hybridization of geese breeds on the growth performance and characteristics of carcass and processing methods. There were five experiments and three replicates for each treatment. The A was Brown Chinese geese. The B was White Chinese geese. The C breed composition was White Chinese geese 50%

and White Roman geese 50%. The D breed composition was White Chinese geese 25% and White Roman geese 25% and Brown Chinese geese 50%. The E breed composition was White Chinese geese 75% and White Roman geese 25%. At 16 weeks of age, 8 goslings (4 males and 4 females) were sampled from each pen and sacrificed for measurements of carcass traits. The results were shown the body weight for C group was highest among the five groups at 16 weeks of age. The dressing percentage of carcass and yields of cut-up parts of breast and back, thigh, head and neck, wing, feet, abdominal fat for Chinese geese and four hybrid combination geese were A group 68.21, 39.37, 19.81, 13.03, 21.91, 4.59 and 1.29%; B group 70.44, 40.26, 19.71, 14.49, 19.90, 4.27 and 1.37%; C group 68.93, 40.08, 21.20, 14.33, 18.93, 4.26 and 1.20%; D group 71.26, 41.46, 19.79, 14.18, 18.41, 4.27 and 1.89%; E group 68.52, 39.30, 20.64, 14.08, 19.19, 4.33 and 2.46%, respectively. Geese processing methods by Liquor-



Chinese hybrid geese

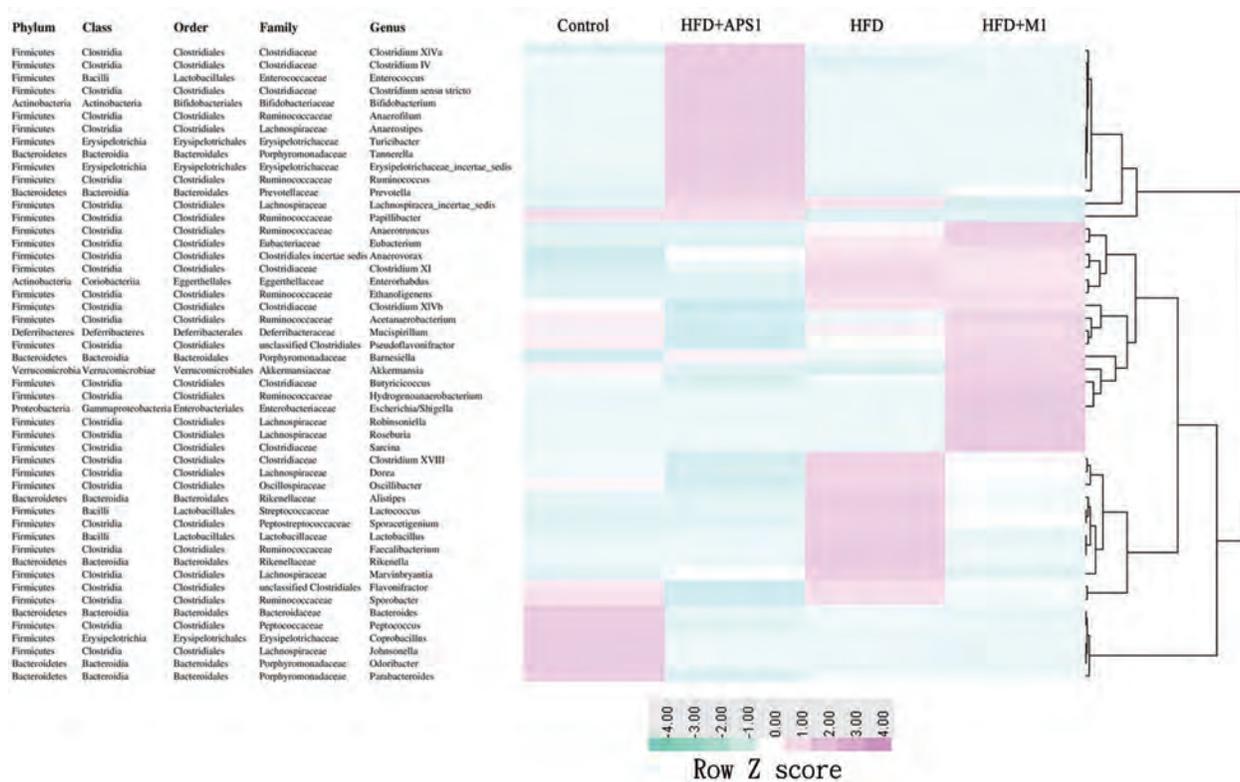
Soaked has better evaluation. The data can be applied by the meat processors.

(C. C. Hsiao, S. D. Wang, C. M. Wang and Y. S. Jea)

Effect of *Lactobacillus mali* APS1 on intestinal microbiota in diet-induced obese mice

Gut microbiota help physiological balance for the host, including intestinal function, immunological regulation and nutritional status, which develop a symbiosis system in gut to health maintenance. Fat-enriched diet may change the differences of gut microbiota composition between healthy and obese cases and become the key factor of metabolic diseases. *Lactobacillus (Lb.) mali* APS1 is a Gram-positive rods and non-motile. This strain demonstrated a body weight and homeostasis-modulating activity *in vivo*. In order to understand the relationship between obese and

composition of gut microbiota, the mice fecal bacterial 16S rDNA was extracted then detected by pyrosequencing method. Results indicated that mice fed with high-fat diet (HFD) induced important changes in the microbial composition, especially the increase of Firmicutes phylum. On the other hand, supplementation of the HFD diet with *Lb. mali* APS1 could maintain prominent changes in gut microbiota. It restored the number of bacteria from Bacteroidetes phylum, which were decreased due to HFD feeding. (Y. C. Lin)



Effect of *Lb. mali* APS1 on intestinal microbiota in high-fat diet (HFD)-induced obese mice. Heat map representation of the genus-level bacterial composition of the microbiota of four groups

Study of processing procedure and composition analysis of extract from turkey and quail meats

This study was conducted to evaluate heating conditions on water soluble nitrogen, amino nitrogen, thermal residual collagen contents and sensory evaluation of the aqueous

extracts and the concentrated from turkey meats or quails. The turkey and quail carcasses were purchased from local factory. The turkey carcass was cooking at 95°C and then the breast meat

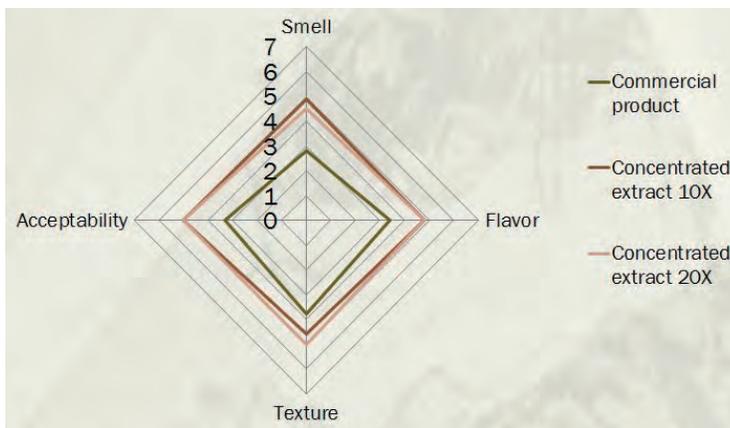
and the essence were sampled after heating for 1.0, 1.5 or 2.0 hours. After two hours of cooking time, the aqueous extracts were concentrated to 6-8 times. The results showed that the contents of water soluble nitrogen, amino acid nitrogen, thermal residue collagen in the turkey essence were $6.92 \pm 0.12\%$, $0.30 \pm 0.02\%$ and $49.87 \pm 4.14 \text{ mg/mL}$, respectively. The data was significantly higher than other treatments. On the other hand, quail carcass was washed and

steamed at 95 or 105°C and the essence was sampled after 40, 80 and 120 minutes. The production rate of quail essence steamed at 95°C was higher than the essence steamed at 105°C. The water soluble nitrogen, amino acid nitrogen and thermal residue collagen content of quail essence were increasing along with the heating time ($P < 0.05$).

(*R. J. Tu, Y. C. Chen, M. R. Lee, W. S. Chen and C. Y. Kuo*)



Turkey essence



Sensory evaluation results of turkey essence

Development and application of preserving technology for domestic fresh duck meat

This study was conducted to develop the preserving technology of domestic fresh duck meat for extending the shelf-life and improving the meat quality. The existing slaughter processing was also checked to identification of hazards and critical control points (CCP) monitoring parameters for follow-up studies of reference. Two hundreds of local mule duck were selected in this experiment. Two batches of commercial slaughter were done in the factory. Four groups of deboned duck breast meats were

soaked preserving solution with 0.0, 0.5, 1.5 and 3.0%, respectively. Then, the meats were vacuum packaged after drying, and stored at 4°C for further analysis. The results showed that total plate count and coli form numbers of the meats soaking preserving solution were lower than the numbers of the control. The K values of all the treatments were lowest on the second day during storage. However, the meat color and pH value of meats were not different significantly whether soaking preserving solution or not. During the



Chilling procedure



Commercial vacuum package

storage of 7 days, the TBARS and VBN contents of all treatments were lower than 0.4% and 12.5%, respectively. In summary, the meat quality of all the treatment was corresponding to the limit of the regulation. This study also found

that the quality and temperature of cooling water played the most important role on the improvement of meat quality.

(*R. J. Tu, T. Y. Kuo, M. R. Lee and W. S. Chen*)

Extracts of fresh or dried spices replace partly nitrite for developing meat products

This experiment was conducted to investigate the effects of garlic and turmeric extracts addition on the quality of frankfurters in order to reduce the amount of nitrite. Local fresh garlic and yellow or red turmeric were purchased from the market and were extracted separately by distilled water or different levels of alcohol. DPPH scavenging antioxidant activity, total phenolic content and ferrous ion chelating ability in the garlic or turmeric extracts were detected. Then, the suitable treatments with the best antioxidant activity were prepared for further processing. The amounts of added garlic or turmeric extracts were 2.0% (w/w) of frankfurters. Also, the amount of nitrite in the garlic or turmeric treatments was 100 ppm compared to 150 ppm in the control. Residual amount of nitrite, meat color, TBARS value, pH value, sensory evaluation and storage test were detected. The results showed that residual amounts of nitrite were 45 ppm in the control, 34 ppm in garlic treatment and 29 ppm in

turmeric treatment. The meat color was tested by Hunter Lab. The L and b values of frankfurter added turmeric extract were significantly higher than the control and the garlic treatment. However, the sensory evaluation result showed that the garlic treatment and the control had better scores than the turmeric treatment ($P < 0.05$). The number of total plate counts and TBARS of all treatments were within the regulation during the two-month storage at 3°C. It showed that the quality of these products was still preserved in good condition.

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



Frankfurter sausage with garlic extract



Frankfurter sausage with turmeric extract

Study of indigenous and imported broilers on distinguish methods

The purpose of the study was to investigate the differences among cold, frozen and imported frozen thigh of broilers. The near infrared spectroscopy, NIRS, was utilized to scan samples and try to find a quick method to distinguish indigenous and imported thigh of broilers.

The analyzed items were proximate analysis, pH values, cooking loss, color determination, TBARS values, zinc, iron and NIRS analysis in order to compare the quality among samples. The results showed that the moisture content of imported thigh of broilers was higher than that



Indigenous chill broiler



Indigenous frozen broiler



Imported frozen broiler

of indigenous cold and frozen chicken thigh of broilers but the crude protein, crude fat and ash content of imported thigh of broiler was lower than that of cold and frozen chicken thigh of broilers. In addition, pH values and cooking loss of imported thigh of broilers were higher than those of indigenous cold and frozen broilers. *A* and *b* values of imported thigh of broilers were higher than those of indigenous cold and frozen thigh of broilers. TBARS values of imported thigh of broilers were twice higher than those

of indigenous frozen thigh of broilers and 2.5 times higher than those of cold thigh of broilers. The spectrograms of NIRS of three groups were shown different compared databank only one from 32 samples which cannot match the databank to distinguish indigenous or imported thigh of broilers. More samples can be created to increase to databank in the future for the quick distinguish method parameter.

(*T. C. Wan*)

The comparison of physicochemical properties in poultry fat with purification

This experiment was conducted the extraction of poultry fat in directly dry rendering method, and compare the physicochemical properties with purification. The results showed that before and after the purification, the main fatty acid contents in the poultry fat were oleic acid, palmitic acid and linoleic acid. After purification, the acidic values (AV) in poultry fat could reduce to 0.3 mg KOH/g fat. The iodine values (IV) and unsaturated fatty acid (UFA) content were significantly reduced in purified duck fat, but increased in purified chicken and

goose fat. The saponification values (SOV) were not related to purification. With purification, the peroxides value (POV) in goose fat could get lower from 24.3 to 9.84 meq/kg fat, but get increased in chicken fat. The monounsaturated fatty acid (MUFA) were higher but the polyunsaturated fatty acid (PUFA) were lower in chicken and goose fat after purification. In conclusion, the purification methods in this experiment were useful for duck fat, because it could reduce the AV, POV and PUFA.

(*H. J. Lee, M. R. Lee, Y. C. Lin and C. Y. Kuo*)



The experiment of SOV in poultry fat



The duck oil after purification

The comparison of fatty acid components in duck fat with temperature partition

This experiment was used the duck fat with dry rendering method in reduce pressure and low temperature to render and purify and temperature divided in 10 and 18°C and tested the fatty acid to know the different between the beginning and final stage of purification and temperature partition. The results showed that

the components of main fatty acids in duck fat in every treatment were almost the same. The carbon chain lengths are almost between C₁₂-C₂₀. The most content in saturated fatty acid (SFA) was the palmitic acid; in mono-unsaturated fatty acid (MUFA) was oleic acid, and in poly-unsaturated fatty acid (MUFA) was linoleic

acid. The long chain fatty acids bigger than C_{22} decreased or transferred and the significant lower contents were observed in MUFA and ω -3 fatty acid in duck fat after purification. After temperature partition, the lower the freezing point, the lower the MUFA and the higher the SFA. The highest ω -3 and ω -6 fatty acid content were observed in the duck fat with 10°C freezing point. The results also showed that the purified duck fat with dry rendering method and temperature partition could increase the content of MUFA stable in heating, and the functional fatty acid such as ω -3 and ω -6, and also could

promote the quality of duck fat.

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



The duck oil after temperature partition

Reuse of waterflow by-product: use collagen extraction in duck and goose byproduct

The purpose of this study was to develop the technology of collagen extraction in duck and goose byproduct. The sample of trachea, lung, heart, liver, intestine and feet of duck and goose were collected from the waterfowl slaughterhouse. The analysis of chemical composition and the collagen extraction were proceeded. The result showed the duck feet and goose feet had the highest crude protein (23.3% and 22.4%) and

the lowest moisture. The contents of collagen extraction from goose feet were reached 66%, which were close to the extraction from chicken feet. The study had established the extraction methods for collagen from waterflow byproducts. The further application could be focused on the investigation of the characteristic of collagen from different sources.

(S. C. Liao, S. C. Chang, M. J. Lin and T. Y. Lin)



The precipitate of the goose feet collagen after the salting-in process



Extraction collagen from freeze-dried geese feet

Effect of *Lactobacillus mali* on high-fat diet-induced obesity in rat model

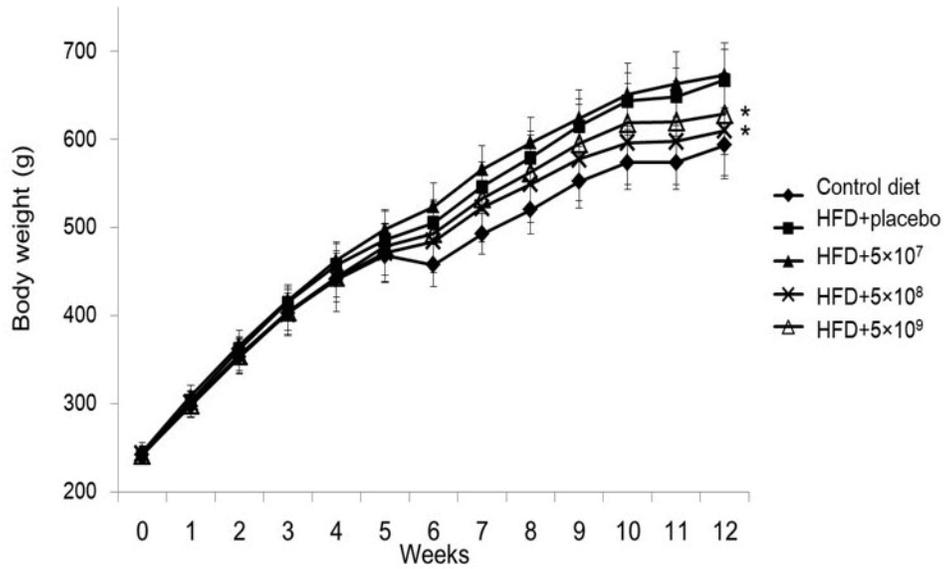
Obesity is a widespread disease in westernized society. A number of studies indicated that gut microbiota influenced the lipid metabolism and blood glucose homeostasis in obesity and non-alcoholic fatty liver disease. Therefore, targeting the gut microbiota could be the potential approach to improve obesity. *Lactobacillus mali*, a probiotic strain isolated from sugary kefir, has been demonstrated several health benefits *in vivo*. In the present study, we extended the above observations and

evaluated the suppression feature of obesity *in vivo*. In experimental design, 7 weeks old male SD rats were challenged with high-fat diet and administrated with *Lactobacillus mali* at different concentration per day by gavage for 12 weeks. The results showed that, in contrast with negative control group, administration of *Lactobacillus mali* significantly reduced approximately 14% body weight gain and improved food efficiency and manipulated gut microbiota composition. Reduction of blood glucose level

and increase of GLP-1 expression in serum were observed. Administration of *Lactobacillus mali* also could improve hepatic steatosis in HFD-fed rat. In conclusion, the results in this study have

provided the scientific evidences, showed the potential capabilities of *Lactobacillus mali* in anti-obesity.

(Y. T. Chen, Y. C. Lin and M. J. Chen)



Effect of *Lb. mali* on body weight of HFD-induced obesity mice for 8 weeks.

*P < 0.05, **p < 0.01, ***P < 0.001 compared with CT.

#P < 0.05, ##p < 0.01, ###P < 0.001 compared with HFD.

Livestock Management

Greenhouse gases produced from cattle manure composting process with mechanical turning

The amounts of greenhouse gas (GHG) emission from livestock excreta, which includes CH₄ and N₂O, depends on the operation parameters of composting treatment. The purpose of this study is to investigate the amounts of GHG produced from cattle manure composting processes including drying, fermentation with mechanical turning and secondary fermentation. The manure scrapped from barn and separated from a solid-liquid separator was collected with 84.3% of water content, and be air dried for eight days to 77.1% of water content for test 1, while the manure of test 2 was air dried to 70% water content, then the manure were moved into the fermentation tank. The amount of CH₄ and N₂O produced in the air-day process of test 1 were 7.86 and 1.29 kg, respectively, that was 108.3 kg of CO₂ dioxide equivalent. Compared to test 1, test 2

with less water content dramatically reduced the production of CH₄, while the N₂O production showed little difference and the average concentrations of N₂O were around 50 mg/m³. In the fermentation process, the amount of CH₄ generated were 10.78 and 2.10 kg for test 1 and test 2, respectively. The latter was only 19.5% of the former. The amount of N₂O produced were 0.13 and 0.11 kg for test 1 and test 2, respectively. In the secondary fermentation process, the trend of CH₄ and N₂O production was similar to the fermentation process. The results showed that the initial water content of cattle manure is a key factor of CH₄ production from the fermentation process, so control on water content is an important strategy for reducing greenhouse gases from the composting process.

(M. P. Cheng, T. H. Hsiao, H. W. Ou and T. F. Shiao)

The quantity and quality of poultry litter-a comparison between red-feathered and black-feather native chicken

Red-feathered (RF) and black-feathered native chicken (BF) are the main species of native chicken raised in Taiwan. The object of this investigation was red-feathered and black-feathered native chicken farm. The quantitative and qualitative data of poultry litter was collected by weighting and sampling analysis for the farmer's, government's and academic's information. The data of 16 native chicken farms and 32 samples were analyzed by multiple factors analysis with species and season as factors. The results showed the average dry weight of RF litter was 1.27 kg/bird, which was significantly ($P < 0.05$) higher than that of BF litter at 1.05 kg/bird. The results of quality analysis of poultry litter showed the moisture, organic carbon and total nitrogen contents of RF litter were 33.1%, 39.6% and 4.4%, respectively, which were significantly ($P < 0.001$) higher than those of BF litter at 23.1%, 34.9% and 3.7%, respectively. However, the pH and ash content

of RF litter were significantly ($P < 0.001$) lower than those of BF litter. The copper contents of RF and BF were 57.9 and 51.1 mg/kg and the zinc contents were 347 and 339 mg/kg. There was no significant difference among species. The average dry weights of litter were 1.25 and 1.10 kg/bird in cool and hot season, respectively. The pH, phosphorus and potassium contents were significantly ($P < 0.01$) higher in hot season. There was significant interaction between season and species factors in the average dry weight of litter, moisture content, pH and zinc content.

(M. P. Cheng, C. S. Chung, T. M. Su, T. H. Hsiao, C. C. Hong and C. F. Lee)

Effects of litter material on the growth performance, excretion and ammonia concentrations of chicken house for broiler

The purpose of this study was to investigate the effects of litter material on the growth performance and excreta amount of broiler chicken and ammonia concentration of chicken house. A total of 720 one-day-old Cobb commercial broilers were assigned to four litter treatments with different volume ratio of rice hull and rice straw, those arrangements were respectively rice hull 100% (group H100), rice straw 25% plus rice hull 75% (group H75), rice straw 50% plus rice hull 50% (group H50) and rice straw 75% plus rice hull 25% (group H25). Each treatment had four pens and each pen raised 45 birds. Feed and water were provided *ad libitum* during the whole experimental period from 1 to 35 days of age. The results showed that the survival rates of broiler reached 97% for all of the treatments. There were no effects of different litter materials on the average

daily gain, average daily feed intake, gain/feed of the broilers. The ammonia concentration measured at the entrance of group H75 chicken barn was significantly higher ($P < 0.05$) than that of group H100 at 18 days of age. The barn H25 had higher ($P < 0.05$) average ammonia concentration than groups H100 and H50 at 25 days of age, but did not affect the ammonia concentration at 32 days of age. The dry weight of manure litter and excreta produced were between 1.49-1.67 kg/bird and 17-20 g/bird/day during the experiment period. In conclusion, using rice straw to replace rice hull as litter material do not affect the growth performance of broiler and ammonia concentration of chicken house.

(T. M. Su, H. L. Liu, C. H. Chung, T. H. Hsiao, Y. F. Lin and M. P. Cheng)

Effects of floor types on growth performance of grower-finisher pig and pig house's water consumption and wastewater quantity during hot season

The purpose of this study was to investigate the effects of floor types on the water consumption and waste-water quantity of pig house during the hot season, and their the growth performance of grower-finisher pigs. A total of 72 head 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 hot season (from Jun. to Sep.). Each group consisted of four pen replicates of six pigs per each pen, half barrows and half gilts each. The groups of SOF and PSF were washed once daily, and TSF group was washed once every 3 or 4 day. Feed and water were supplied *ad libitum*. The feeding trial was terminated when the average BW of pigs reached 115 kg. The water consumption and wastewater quantity of pig house, quality of wastewater and their growth performance of pigs were measured. The results showed that the floor types did not affect on average daily feed intake and feed efficiency of pigs. During the growing stage,

the water consumption of SOF, PSF and TSF groups were respectively 41.60, 34.98 and 17.79 L/d/head and the waste-water quantity were respectively 33.87, 28.80 and 16.43 L/d/head. The water consumption of PSF and TSF groups were respectively about 84.09% and 42.78% of SOF, and the quantity of wastewater of PSF and TSF groups were respectively about 85.00% and 48.50% of SOF. During the finishing 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 reduced quantity of wastewater during the hot season.

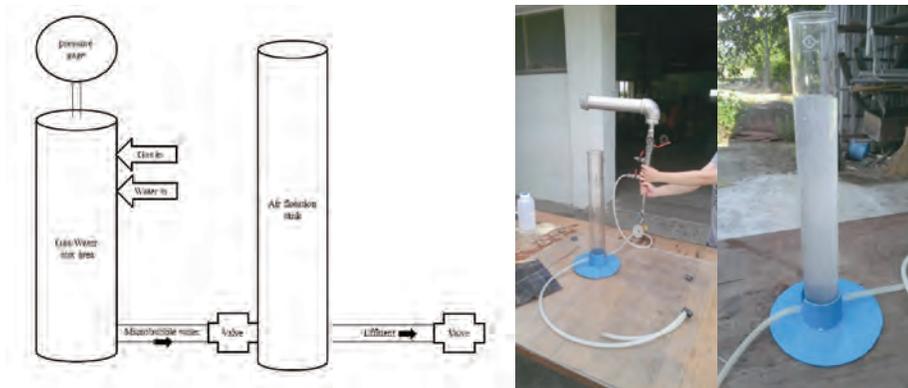
(T. M. Su, Y. H. Weng, C. H. Chung, M. C. Cheng, T. H. Hsiao and M. P. Cheng)

Effect on dissolved air flotation dairy wastewater treatment

The purpose of this study was to investigate the effect of dissolved air flotation (DAF) process on dairy cattle wastewater treatment with a laboratory experiment. Five hundred milliliters of wastewater after solid-liquid separator (ASL), after anaerobic digestion (AND) and after aerobic digestion (AAT) were pumped into the flotation tanks, respectively. There different coagulant (Polyaluminium chloride, PAC, cationic polymer, CPM and ferric chloride solution, ClFeS) was added into the AND and AAT, respectively. Then, 500 mL of pressurization water (5 kg/cm^2) was injected into the bottom of the flotation tanks and the supernatant was sampled after 1 min to analysis suspended solid (SS) and chemical

oxygen demand (COD). The results revealed that the removal efficiency on ASL was the best that removal efficiencies of COD and SS were 27.7% and 47.9 %, respectively. DAF treatment of DCW with PAC (600 and 200 mg/L), CPM (100 and 4 mg/L) and ClFeS (100 and 30 mg/L) can meet the effluent standards. In conclusion, The DAF process can be set after the solid-liquid separation to reduce the organic loading of the following process in the full scale the dairy wastewater treatment system, while that can be set after AAT with coagulants to reduce the production of chemical sludge.

(M. C. Cheng, T. H. Hsiao, T. F. Shiao, H. W. Ou and M. P. Cheng)



Dissolved air flotation model

Adverse effect of nonylphenol on fertility in White Roman geese

Nonylphenol (NP) is an estrogen like compound, which is regarded as an endocrine disrupter capable of interfering with the hormonal regulation of numerous organisms. It originates principally from the degradation of nonylphenol ethoxylates which are widely used in industrial, agricultural, commercial and household applications. Water fowls are mostly raised with water pools in Taiwan. The water coming from either underground or rivers may be contaminated with NP which may affect birds' fertility. Therefore, this study was to investigate the effect of nonylphenol on fertility in male White Roman Geese (WRG). Forty WRG at the age of five weeks were randomly assigned into five treatments, including, control, oral administration of soybean oil, 1 (NP1), 10 (NP10) and 250 (NP250) mg NP dissolved in

soybean oil /kg body weight. All treatment were applied dairy for sixteen months. Semen from male WRG was collected during a period of twelfth months for analyzing counts, viability and DNA integrity (SCSA) of sperms. Two WRG in the same treatment were randomly selected and naturally mated with three untreated females (2 years age) for four months and fertility was measured by detection of embryo development after incubation for 13 days. The result revealed that there was no significant difference among the treatments in SCSA and sperm viability. However, the fertility of eggs in NP250 was significantly lower than those in controls ($P < 0.05$).

(M. C. Cheng, I. H. Hsin, C. M. Hung, T. Y. Kuo, M. Y. Tsai, M. P. Cheng, S. C. Chang, K. H. Tso and Y. K. Fan)



Treatment on geese and processes of semen collection and evaluation

Emission of methane from livestock wastewater treatment system during hot season in Taiwan

The purpose of this study was to investigate the emission of methane from livestock wastewater treatment system during hot season in Taiwan. Methane emission of first sedimentation plant (FSP), aerobic plant (AOP) and discharge plant (DCP) was collected by sampling hood from four dairy (69-230 head/farm) and six pig farms (800-20,000 heads/farm) in northern, central, and southern Taiwan. A biogas collection tube in anaerobic was set up to collect the gases. A flow meter was set up for the record of gas production. The gas sample was analyzed for methane by gas chromatography-TCD and FID. Results revealed that the averaged

emission factor of methane was 232 g/ head/day in which FSP, AOP and DCP averaged emission percentage were 65.6%, 22.2%, 8.20% and 4%, respectively of total emission amount in wastewater treatment system of dairy farm. The averaged emission factor of methane was 32.6 g/ head/day in which FSP, AOP and DCP averaged emission percentage were 60.3%, 35.6%, 2.63% and 1.97%, respectively of total emission amount in wastewater treatment system of pig farm. Data of this study could be a reference for waste water management.

(M. C. Cheng, H. F. Lee, T. F. Shiao, H. W. Ou and M. P. Cheng)



Methane emission collected by sampling hood

Evaluate of improve effect on effluent water of dairy cattle with dissolved air flotation

The wastewater treatment system of dairy cattle in Taiwan is usually a sequential process from solid-liquid separation, anaerobic digestion (AD), aerobic treatment (AT) and final precipitation to discharge. Dairy cattle is herbivorous animal, so there is large amount of suspended fiber in its manure and wastewater. Some fiber cannot be removed with the solid-liquid separator and precipitated in wastewater treatment system. Therefore, the purpose of this study is to investigate the effect of applying a dissolved air flotation system (DAFS) on the efficiency of dairy cattle wastewater treatment system by on-site experiments with continuous flow. The COD and SS of influent and effluent of DAFS, AD and AT were analysed when the DAF was installed after solid-liquid separator,

and the data were compared to those of treatments without DAFS. The results revealed that the removal efficiency of COD and SS of DAFS were 50.8 and 56.2%, respectively. The COD and SS concentrations of AD effluent with DAFS were lower than those without DAFS at 53.5 and 43.0%, respectively. The COD and SS concentrations of at effluent with DAFS were lower than those without DAFS at 46.6 and 49.7%, respectively. In conclusion, DAFS could be applied to reduce the COD and SS of dairy wastewater after solid-liquid separation, so the discharge water quality could be improved by the following treatment.

(M. C. Cheng, T. H. Hsiao, T. F. Shiao, H. W. Ou and M. P. Cheng)



Dissolved air flotation system

Benefit evaluation on irrigation of dairy wastewater for pasture

It's estimated by dairy cattle numbers that, there is about ten billion tons of dairy wastewater per year in Taiwan, which contents nutrients for plant. Due to the limitation of regulation, the case of irrigating livestock wastewater for crops was shown just in recent years. Most of the cases were irrigation of dairy wastewater. Therefore, the purpose of this study was to investigate the benefit of three cases of irrigation of dairy wastewater approved by Council of Agriculture, Executive Yuan, R.O.C. (Taiwan) at the end of the this year. The numbers of dairy cattle were 191, 245 and 360, respectively and the crops were forage corn, Napiergrass and Pangolagrass, respectively in these cases. The results revealed that the total nitrogen concentrations in dairy wastewater were 354, 450 and 868 mg/kg, respectively and the amount

of wastewater irrigated were 711, 1,368 and 417 ton/ha/year. Therefore, the equal volume of groundwater can be saved. At the same time, 252, 616 and 362 kg/ha of chemical nitrogen fertilizer can be replaced, that reduce 1.23, 3.01 and 1.81 kg/ha of carbon dioxide emissions in these three cases, respectively. In the other hand, the cost of chemical fertilizer were 13.4, 32.8 and 19.3 thousand dollar/ha/year, respectively, can be saved, when it is estimated by the price of Taiwan fertilizer No.1 number one. The cost of irrigation were 48.9, 30.5 and 21.1 NTD/ha in these three cases. In conclusion, because the need of nitrogen was Napiergrass is higher, the reduction of CO₂ emission was the highest among these three cases. Irrigation of livestock wastewater for pasture can reuse the nutrients in the wastewater reduce the CO₂ emission and

reduceto the payment of water pollution control fees in the future.

(*M. C. Cheng, C. H. Liu, T. F. Shiao, J. B. Lin and M. P. Cheng*)

The effect of irrigation of dairy manure wastewater at the pasture area on the soil, pasture and groundwater quality

The purpose of this study was to evaluate the effect of irrigation of dairy manure anaerobic wastewater at the pasture area on the soil, pasture and groundwater quality. The dairy manure anaerobic wastewater of dairy farm contains many nutrients for plants and can partially replace the chemical fertilizers. It can decrease usage of chemical fertilizer and energy consumption on the aerobic treatment of wastewater. Using the dairy manure anaerobic wastewater to irrigate the pasture, including Napiergrass, Pangolagrass (A10, A13 and A14) and forage corn, and then feed the dairy cattle with the pastures. The nutrient sources of the napiergrass land are as follow: wastewater group (W_1), half wastewater and half chemical fertilizers group ($W_{1/2}$) and chemical fertilizers group (C). The physical and chemical properties of soil and the yields of the napiergrass with different nutrient source will be monitored during the period of experiment. There are upstream and downstream wells in the pangolagrass land. During the irrigation of the dairy manure anaerobic wastewater on the pangolagrass land, the qualities of groundwater,

including TN,TP, K, Ca, Mg, Cu and Zn will be monitored in this study. The results showed that soil pH of napiergrass area were 5.50, 5.09, 4.51 for W_1 , $W_{1/2}$ and CK significantly different ($P < 0.05$). The EC of soil in the W_1 and $W_{1/2}$ were significantly lower than that in treatment CK (87.6, 120 vs. 182 $\mu\text{s}/\text{cm}$) ($P < 0.05$). The OM, TP, Cu and Zn of soil were not significantly different among three groups. The TN, CP, TP, ADF, NDF, Cu and Zn of Napiergrass were not significantly different among three groups. The napiergrass yield of $W_{1/2}$ and C groups are similar. The soil OM, TN and EK of pangolagrass area are a little increased. The pangolagrass CP and yield of A10, A13 and A14 are higher than control. The pH, EC, TN, TP, Cu and Zn of upstream and downstream groundwater were not significantly different after irrigating wastewater. The soil OM, TN, AP, EK, Cu and Zn of forage corn area were not significantly different after irrigating wastewater. The forage corn yield of C group and CP of $W_{1/2}$ group is highest.

(*C. H. Liu, C. H. Lu, J. B. Lin, M. C. Cheng, T. F. Shiao and M. P. Cheng*)



Using dairy manure wastewater to irrigate at Pangolagrass pasture



Using dairy manure wastewater to irrigate at Napiergrass pasture



Groundwater collection



Using dairy manure wastewater to irrigate at forage corn

Evaluation on secondary solid-liquid separation efficiency of dairy wastewater

The runoff solid-liquid separator was installed with stainless-steel net with pore sizes of 0.47, 0.37 and 0.3 mm, respectively to investigate the solid-liquid separation efficiency of cattle wastewater in this study. The drying process and removal of air pollutant from drying of mechanical scraping cattle manure, water wheel type and runoff-type solid-liquid separation residues was also studied. The raw wastewater and wastewater after waterwheel type separation was pumped to the runoff solid-liquid separator with pore sizes 0.47, 0.37 and 0.3 mm. The results showed the separation with larger pore size can treat larger amount of wastewater at the same time, and got smaller amount solids containing less water. The COD, SS and TS concentration of wastewater before separation were significantly higher than those after separation, while the BOD concentrations

of wastewater showed no differences. Then, the wastewater after 0.75 mm was separated sequentially with runoff type solid liquid separators with 0.47 and 0.3 mm pore sizes net. The extruder could not dry the solids from 0.30 mm net.

(T. S. Hsiao)



The runoff solid-liquid separator

Study on the moisture removal of cow dung solids

The general way to clean the cow barn is direct flushing or flushing after the mechanical scraping, and then the wastewater is treated by runoff type or wheel type solid-liquid separator to collect the solid parts. The high moisture content solids need to be dried before composting. The mechanical scraping manure, the solids collected from runoff type and wheel type solid-liquid separator was dried in a solar drying house with the effective area of 21 m² in this study. The air blower and exhaust systems of the drying house was set to start 10 minutes every 0.5 hours, the exhaust fan blowing when the blower started. The drying house also equipped with a knife rake turning machines, it worked once at 8:30, 10:30, 11:30, 13:00 and 15:00 respectively, during the dewatering of the cattle manure or solids. The manure solids sample was collected everyday to analyze the moisture content before and after dewatering.

The results of drying house experiments showed the time needed for drying cow dung solid from runoff type separation, wheel type separation and scraping machine to 60% of moisture contents were 8, 8 and 11 days, respectively. The moisture removal efficiencies were 0.27, 0.22 and 0.25 h/kg, respectively.

(T. S. Hsiao)



Solar drying house

Unit mass estimation and effect of in-house windrow composting process on the pathogenic microbes levels of broiler litter

The quantities and quality of litter of nine broiler farms were investigated in the cool and hot season, respectively. The results showed that

the amount of broiler litter generated were 1.09 and 1.13 kg/head/cycle in the cool and the hot season, respectively. Those were calculated as

13.6 and 14.6 kg/m²/cycle by area. The moisture contents of broiler litter were 36.5 and 34.2%, so the amounts of litter were 0.69 and 0.74 kg dry matter/head/cycle, respectively. It was found that the Zinc concentration of litter samples from two farms cannot meet the standard of Zn concentration for the livestock manure compost. The experiments on the effect of different methods of in-house windrowing on the biosecurity were designed as two kinds of moisture content (30, 35%) and two depth (40, 55 cm) of compost piles. All the experiment groups were windrow composted in-house for 12 days and were turned twice during the composting processes. The results showed that the core and surface temperature of the composting pile were above the sterilize temperature (55°C) for over three days for all of the treatment groups. The population of aerobic microbes, anaerobic microbes, coliforms, *Staphylococcus aureus*, *Salmonella*, *Campylobacter jejuni* and *Clostridium perfringens* in the broiler litter signi-

ficantly declined during the composting processes. In conclusion, the basic requirement for sterilization of broiler litter (> 55°C for 3 days) can be reached by in-house windrow composting. The population of the pathogenic microbes in the broiler litter significantly declined during after the composting process.

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



In-house windrow composting treatment of broiler litter

Research on the fermentation process model of poultry manure in small laying hens farm

This study was conducted to develop a chicken manure fermentation machine for small scale chicken farms. Moreover, we tried to manipulate the ratios of fermentation materials to improve the efficiency of fermentation and decrease the time of compost processing. In



Different chicken manure / rice hull ratio pretest

this year, we adopted the fermentation machine which built up last year and compared the fermentation efficiency between chicken manure, rice hull mixtures with and without *Bacillus subtilis* under the same physical condition. The preliminary data showed that no matter *Bacillus subtilis* added or not, the temperature of compost can reach the standard of pasteurization to kill the pathogens. Furthermore, when *Bacillus subtilis* added into the mixture, the fermentation rate was accelerated and the time of compost maturity was brought forward 3 days. Hopefully, we want to optimized the condition of this machine and provide this technique to local chicken farms.

(H. T. Chu and A. K. Su)

The carbon footprint of domestic dairy production by life-cycle assessment

The purpose of this study is to evaluate the carbon footprint of dairy production with the management data of a dairy farm, and to integrate the research results on nutrition,

management and forage grass to complete the management model of greenhouse gas mitigation for the dairy farm. The carbon footprints of the raw milk evaluated by the

life cycle assessment were 1.15-2.07 kg CO₂ equivalent from January 2014 to October 2015. The most important factors on carbon footprints were the milking efficiency and the energy consumption. The results of planting forage showed the amount of CO₂ emission from the process of growing Napier grass with dairy wastewater was highest, but it reduced the greenhouse gas emissions from the wastewater treatment. However, the results of planting forage corn showed the amount of N₂O emission from the soil was not related to the type of fertilizers, and the N₂O emission factors were 0.27-3.94%, which means less than 4% loss of nitrogen fertilizer as N₂O-N form. On the other hand, the milking cow fed with medium to high quantity of by-product can reduce CH₄ emission per unit of feed. The emission factors

of CH₄ and N₂O from the anaerobic process of dairy wastewater treatment were 82.87 and 0.2074 kg/head/year. Using biogas to generate electricity can largely reduce the CH₄ emissions. The biogas emission rate was 14.4-28.3 m³/day from the 100 tons of anaerobic digester of dairy wastewater. The specific biogas production rate was 204-402 mL/g TS/d calculated by total solid added. The emission factors of CH₄ from the aerated pile and the machinery turn composting processes were 4.35-14.51 and 0.53-5.42 kg/head/year, and those of N₂O were 1.05-3.77 and 0.08-0.39 kg/head/year, respectively. Aeration and reduction of the initial moisture content reduce the greenhouse gas emissions from the cow dung composting processes.

(Y. C. Chi, M. P. Cheng, C. T. Chang, T. F. Shiao, G. J. Fan, C. F. Lee, C. H. Lu and J. B. Lin)

In vivo greenhouse gas emissions of pigs in Taiwan

To establish the national greenhouse gas emission from livestock, this study measured the pig origin. A negative-pressure stainless steel chamber (L465 × W240 × H210 cm) with 30 m³ per hour aeration rate was designed. Five periods of pigs including 2 pregnant sows, 2 lactating sows (with 8 piglets each), 16 growing pigs (BW avg. 24 kg), 6 growing pigs (60 kg) and 5 finishing pigs (90 kg) were measured in 3 consecutive days, respectively. The concentration differences of CH₄ and CO₂ detected from the inlet and outlet multiple air samples were used to calculate the daily

emission factors. Before and after each batch measurement, air recovery test were conducted. Results in daily CH₄ production per head were 8.25 ± 1.04, 14.3 ± 2.51, 0.85 ± 0.04, 1.32 ± 0.24 and 4.65 ± 1.64 g and were 1.98 ± 0.10, 3.98 ± 0.26, 0.77 ± 0.06, 1.31 ± 0.04 and 1.95 ± 0.33 kg for CO₂ production, respectively. According to the raising numbers from the Statistical Yearbook of Agriculture (2014), the in vivo emission factor of CH₄ and CO₂ per pig in Taiwan would be 3.04 g and 1.43 kg.

(C. F. Lee, C. H. Wang, C. R. Wu, G. J. Fan, L. C. Hung, M. P. Chen and T. F. Shiao)

Study of Chinese herbal on anti-coccidiosis of rabbits

The purpose of this study was to investigate different doses of Chinese herbs on anti-coccidiosis of rabbits. Thirty 4-weeks old New Zealand white rabbits were selected and divided into four treatments. Half was male and half was female. Four treatments were: negative control group, positive control group, 0.5% Artemisia and 1.0% Artemisia. All treatment groups were orally given intestinal coccidiosis except negative control group. Rabbits were weighed and fed with treatment diets. After one week's adaptation, feed intake and body weight were recorded and then challenged with 1 × 10⁴ mixed sporulated oocyst. After challenge, feed intake, body weight and excreted ova were recorded

every week for 4 weeks. The results indicated that body weight of negative control group was significantly higher than the other groups at the 5th week (P < 0.05). Feed intake of negative control group was significantly higher than that of the other groups at the 5th and 6th week (P < 0.05). OPG (oocyst per gram of feces) of positive group was significantly higher than that of the other groups at the 7th, 11th, 14th and 21st day (P < 0.05). Coccidiosis drug diclazuril was significantly lower than the other groups at the 11th and 14th day (P < 0.05). We conclude that Artemisia can be added in feed to prevent infection of coccidiosis.

(M. Y. Tsai and C. H. Hsieh)

Study of stocking density on behavior of New Zealand white rabbits

The purpose of this study was to investigate the effects of different stocking density on behavior of New Zealand white rabbit. Thirty four 4-weeks old New Zealand white rabbits with similar body weight and were selected. Half was male and half was female. Two stocking density with 4 head/45cm² or 2 head/45 cm² and two gender were used as factorial design. A total of 4 treatments, each with three replicates were conducted for 6 weeks. Each week was observed for two days including morning, noon and afternoon period. An interval of 10 minutes, intake, rest and drink were recorded during the first 10 minutes. Social activity, explore, jump and self-care behavior were recorded during the last 10 minutes. The results were: 1. For morning period, rest of 2 head/ 45 cm² group was significantly higher (P < 0.05) than that of

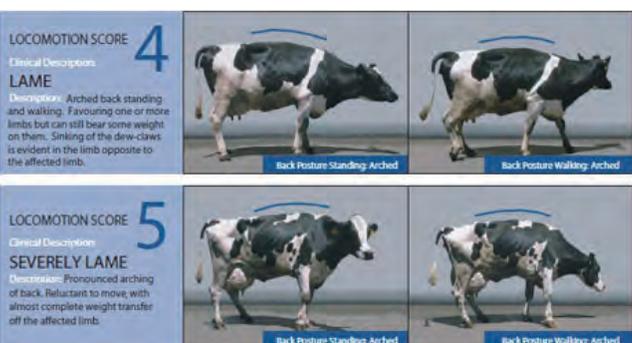
4 head/ 45 cm² group for males. Rest and drink of 2 head/ 45 cm² group was significantly higher (P < 0.05) than those of 4 head/ 45 cm² group for females. 2. For noon period, rest of 2 head/ 45 cm² group was significantly higher (P < 0.05) than that of 4 head/ 45 cm² group for females. 3. For afternoon period, social activity of 2 head/ 45 cm² group was significantly higher (P < 0.05) than that of 4 head/ 45 cm² group for males. The other behaviors such as feed intake, explore, jump and self-care had no significant difference among the groups. Feeding environment and welfare status of experimental rabbits may affect the normal behavior. The welfare of experimental rabbits were needed to be done in the near future to assure the accuracy and reliability of experimental data. (M. Y. Tsai and C. H. Hsieh)

Surface slip resistance grooves impact investigation of Holstein lactating cows by locomotion score

Under the hot and humid environment in Taiwan, harsh feed lot condition often results in hoof health problem for dairy cow and further increases milk production costs. One of the measures to improve feed lot condition is to set up surface slip resistance grooves. This research

takes place in a dairy farm in southern Taiwan with investigation object of a group of lactating cow (about 80 heads). The survey period is 6 months, starting from 1st April to 30th September, with surface slip resistance grooves completed in early May. Survey results were as follows:

Month	April		May		June		July		August		September	
Locomotion score	Mean	n	Mean	n	Mean	n	Mean	n	Mean	n	Mean	n
Tunnel-ventilated b.	2.40	44	2.78	36	2.24	21	1.87	46	2.22	29	2.04	36
Traditional barn	2.58	40	2.56	50	2.33	63	1.96	27	2.22	45	1.97	35
Total lactating cows	2.48	84	2.66	86	2.31	84	1.90	73	2.22	74	2.01	71



Locomotion Score

No significant difference were found between traditional barn and tunnel-ventilated

barn, but after setting up surface slip resistance grooves, locomotion scores decreases representing improvement in hoof health of dairy cows.

(*T. F. Shiao, C. T. Chang, D. W. Yang, H. W. Ou and C. F. Lee*)

Technology in chicken manure co-digestion and its products utilization

This study was aimed to establish optimum mixing ratio of co-digestion of chicken manure and cow wastewater and to investigate the effect of manure compost on the amount and quality of forage fiber. The composting manure condition of manure moisture at 65% and air condition at 3 min/hr could be shorten the composting time, reduce dry matter, total nitrogen and organic matter loss rate, and reduce greenhouse gas production during composting. The results of 10L anaerobic digester showed that the COD, BOD, TS and volatile solids (VS) of the average removal with TS content of 0.5%, 1%, 2% group higher than those of the TS content 4% and 8% group. TS content of 2% mixture of groups, not only had the highest TS/g and VS/g biogas production, but also had the highest methane CH₄ content, in COD removal and TS also reached 84% and 76.9% or more, so it should be a feasible composition. The results of applying cattle-layer compost on the growth of Napier

grass showed that using the half of compost with half of chemical fertilizer was the best model of fertilizing because it had better tip plant height, collar height, and number of tillers. Upright anaerobic fermentation tank water filling time should be extended to reduce the microbial load, increase biogas production; scum liquid directly into the fermentation tank is not recommended for treatment.

(*T. F. Shiao, T. H. Hsiao, C. H. Lu, S. R. Chang, H. W. Ou and M. P. Cheng*)



Anaerobic digester

Friendly feeding model of sows

The purpose of this study was to compare the aggressive behaviour between weaned sows raised in an open pen with or without an automatic animal brush. Thirty six multiparous TLRI Black Pig weaned sows were allocated to open pen (260 × 510 cm) (control group) or open pen with an automatic animal brush (brush group) with three sows a pen for two weeks. There were six replicates (pen) of each treatment. The behaviour of six hours in day time of sows during three days and the 7th and 14th day



Animal brush attracted the sows and an enrichment material for grouping sows

after the regrouping were recorded by video and analysed by video playback. The results revealed that the latency to fight of sows for control group and brush group were 159 and 140 sec, respectively. There was not different between treatments. The fighting frequency hourly of sows within six hours after regrouping was similar between treatments. Brush group tended to have lower total fighting number within two days after mixing and there was 19.6% and 20.9% decrease of fighting of the first and second day after mixing, respectively compared to control group. However, there was not different between treatments. Fighting number was reduced alongside with the grouping time prolonged. The brush group encountered the automatic animal brush 2.2 to 3.7 times within six hours observation during the test day. Therefore the animal brush might attract the sows and tend to reduce the fighting after grouping that could be an enrichment material for grouping sows.

(*H. F. Lee*)

Reducing the aggressive behaviour of grouping pigs by enriched enrichment

The purposes of this study were to compare the effect of aggressive behaviour and growth performance of weaning pigs by setting up a partition board or not in the bare mess floor pen. Sixty weaned TLRI Black Pigs (TBP) at four weeks old were allocated to two treatments. The control group was bare mess floor pen, and the treatment group was a partition board set up in the pen. Each pen allocated six pigs which were from two or three litters. The behaviour regroup of pig within three day and on the sixth day after regrouping was recorded and analysed by video playback. Body weight of each pig and the feed intake of pen were recorded on the first and second week after the test. Results were indicated that the treatment group tended to had lower fighting frequency within six hours after regrouping than the control group. There was growth check of 19.4% and 12.3% for control

group and treatment group, respectively on the first week of the test. Growth performance was similar between two groups on the second week of the test. Therefore the partition board tended to reduce the fighting behaviour of regrouping pigs, but had no significant effect on growth performance.

(H. F. Lee)



A partition board tended to reduce the fighting behaviour of regrouping weaned pigs

The effects of white LED illumination on the laying performance of Brown Tsaiya ducks

The aim of this experiment was to increase the energy efficiency and reduce the carbon dioxide emission via the replacement of fluorescent light bulbs by LED in raising waterfowl. Three different lighting regimes were used on Brown Tsaiya ducks in the experiment as follows: (1) fluorescent light with natural lighting (2) LED white light with natural light and (3) LED white light only. Forty eight ducks were used in each treatment with totally 144 ducks in the experiment. The experiment was conducted from 22 to 43 weeks of age. Data regarding egg laying yield, feed intake, egg shell breaking strength, egg shell thickness, blood traits, behavior observation and reproductive performance were recorded. The results indi-

cated that no significant difference were found on the egg laying yield, feedintake, egg weight, egg shell breaking strength, egg shell thickness, Haugh unit and blood traits between treatments. The results showed that hatchability of duck eggs were lowest in LED white only group. It was concluded that replacing the fluorescent light with LED white light did not affect the ducks' laying performance and their egg qualities, furthermore, at least 40% lighting electrical cost could be reduced. However, more experiment should be conducted to confirm that the effects of different light source on reproductive performance.

(C. H. Su, C. H. Cheng, J. F. Huang and J. H. Lin)



Three different illumination treatments in the experiment

The effects of different LED color (wavelength) on the laying performance of Brown Tsaiya ducks

The aim of this experiment was to investigate the effects of different LED color on Brown Tsaiya ducks laying performance, hoping to improve production efficiency. Ducks were randomly allocated into three different illumination treatment including (1) white LED (2) blue LED and (3) red LED. There were 48 female ducks used in each treatment with totally 144 female ducks in the experiment. The experiment was conducted from 21 to 49 weeks of age. Data regarding egg laying performance, feed intake, egg shell breaking strength, egg shell thickness, blood traits, behavior observation, reproduction performance were recorded. The results indicated that the red LED illumination could stimulate ducks' sexual maturation, whereas the blue LED illumination delayed it. They showed similar egg laying pattern during the middle and late laying period. The feed intake was highest in ducks with red LED treatment may be resulted from the higher egg laying performance. There were significant

lower egg shell breaking strength and higher egg weight of blue LED treatment, nevertheless, no significant difference were found on egg shell thickness and Haugh unit. The fertility of treatments showed no significant difference but the result of lower hatchability rate of red and blue LED treatments need more investigation in the future.

(C. H. Su, C. H. Cheng, J. F. Huang and J. H. Lin)



Different LED color treatments in the experiment

The effect of different breeding environment on Brown Tsaiya duck laying performance and floor laying rate

The aim of this experiment was to investigate the effect of different breeding environment on Brown Tsaiya duck laying performance and floor laying rate. Brown Tsaiya ducks at 0-14 weeks of age were fed with the diet recommended by the Nutrient Requirement Manual (1988), laying diet was given after 14 weeks of age. Feed and water were given *ad libitum* during the experiment. Tsaiya ducks were bred in four different environment (indoor duck house with mesh ground, indoor duck house with rice hull on ground, non-open duck house

with cement ground and non-open duck house with slatted wood) as four treatments, each treatment have three replicated of 20 ducks, with a total of 240 ducks. Data regarding egg weight, egg shell breaking strength, laying performance, feed conversion ratio and floor laying rate were recorded for five continuous days every four weeks from 20 to 40 weeks of age. The results indicated that no significant difference was found on feed intake between treatments in entire experiment but indoor duck house with mesh ground treatment showed a trend of less feed intake. In the egg weight, ducks bred in the duck house with mesh ground had a trend of heavier egg weight than other treatments. No significant difference was found on the egg laying performance between treatments. However, non-open duck house with cement ground treatment had a trend of higher egg laying performance of 84.8% than other treatments. In the feed conversion ratio, no significant difference was found between



Brown Tsaiya duck in laying period

treatments, nevertheless, non-open duck house with cement ground treatment had a trend of better conversion ratio of 2.56 than other treatments. In the floor egg rate, there was no significant difference between treatments, however, non-open duck house with cement ground showed a trend of less floor egg rate of

8.3% than other treatments. In conclusion, ducks fed in non-open duck house with cement ground was recommended when egg weight, egg laying performance, feed conversion ratio and floor egg rate were concerned.

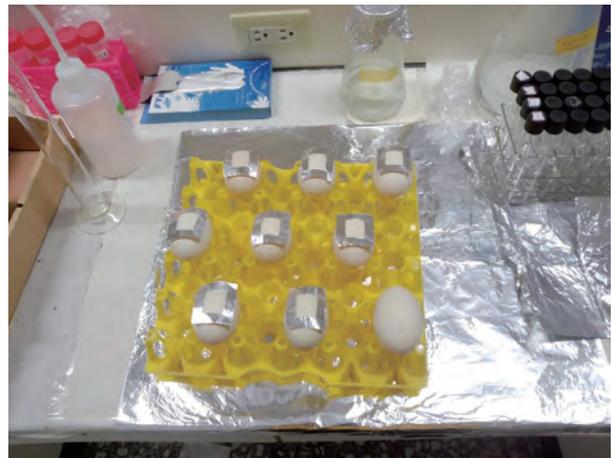
(*J. H. Lin, C. H. Su, Y. A. Lin, C. H. Cheng and J. F. Huang*)

The effects of different disinfection methods on eggshell microbes and hatchability of duck eggs

This experiment was aimed to evaluate the effects of different disinfection methods on eggshell microbes and hatchability of duck eggs. Disinfection methods were divided into two groups: solution spray and air formed type fumigation. In the aspect of solution spray method, we used water, 500 ppm Hi-CIO solution and 500 ppm Quats for 3 and 5 minutes of disinfection. In the aspect of fumigation disinfecting method, we used 2% ozone, 250 and 500 ppm ClO₂ solution, 550 ppm Iodine compounds solution, 1,000 ppm Hi-CIO solution and 3X formaldehyde for 30-120 minutes of disinfection. After disinfection, eggshell microbes and traceability of Brown Tsaiya duck eggs were tested. The results showed that eggs treated with 2% O₃ for 30 minutes, 500 ppm ClO₂ fogs for 30 minutes and spray with 500 pm quaternary ammonium compounds or Hi-

ClO solutions for 3 minutes can significantly decrease the microbes on the egg surface. Moreover, disinfection methods had no negative effects on hatchability of duck eggs.

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



Sampling the microbes on the egg surface

Effect of nest box closure and setting time on Brown Tsaiya duck's nesting location preference

In Taiwan, most laying-duck farmers buy 100 to 120 days-old Brown Tsaiya ducks and domesticate them by driving them into the laying area in the night. To confirm the necessity of domestication for ducks before laying, this experiment was aimed to explore the effect of nest box closure and setting time on Brown Tsaiya duck's nesting location preference. The nest boxes tested included high/low degree of closure and setting boxes 4 weeks before beginning of their laying period (HB and LB) and high/low degree of closure and setting after ducks started their laying period (HA and LA). In this test two hundred and seventy two 17-week-old Brown Tsaiya were raised in a semi-open duck house and randomly assigned to four groups (HB, LB, HA and LA, respectively).

There were two replicate pens in each group with thirty four ducks per replicate pen. During the experiment period the location of eggs laid on the floor, in the nest boxes and partitions of the nest boxes were recorded. The results



The conditions of Brown Tsaiya duck's eggs laid in the nest boxes

showed: in the aspect of effects of age on the laying position, in the early laying period most ducks laid their eggs on the floor; whereas ducks laying on the floor decreased significantly with increased age. In the aspect of effect of closure and setting time, setting nest boxes before ducks

start laying can improve the floor-laying rate, and nest boxes with high degree of closure are more attractive to Brown Tsaiya ducks.

(*C. H. Cheng, C. H. Su, J. H. Lin, J. F. Huang and Y. H. Siao*)

Automatic water buffalo management demonstration system

The data of body weight, body shaped and the tag number of water buffalo can be easily obtained by connecting RFID weight scale, RFID multiple scanners and PDA with special software. The result showed that the percentage of broken RFID ear tag was 3.7% after tagged on the ear of buffalo 5 months later. The percentage of ear tag falling down was 9.4%, whenever those buffalo grazed on shrub pasture during the experimental period. The range for scanning RFID ear tag by PDA is about 1.5 to 2 meters. The software of PDA was designed operating alone or connecting server by wireless. The stability and accurate of body weight and body shaped data collecting or renewing were 100% precisely. RFID weight scale can weight buffalo automatically, and transfer data back to server. The radius of RFID multiple scanners is about 2 meters. When a buffalo herd walked

through below the RFID multiple scanners, every buffalo which had RFID ear tag can be detected and showed up to the computer screen right away. The percentage of data accurate was 95%-100%, when using RFID multiple scanners to detect a herd of buffalo under twenty at this moment.

(*P. H. Chuang and A. K. Su*)



Automatic electronic scales system

The current status of game chicken industry in Hualien-Taitung area

According to the agricultural statistical yearbook of 2013, the number of game chickens is around 1% of total broilers in Taiwan. Moreover, the game chicken from Hualien-Taitung area almost occupied 41% of total game chicken population. Compared to the west region of Taiwan, Hualien-Taitung area is scarcely populated and really appropriate for producing free-range poultry. Furthermore, these unique free-range broilers become a well-known delicacy. "Game hen" is a broiler breed from game chicken crossbred with large

size red feather native chicken and favored by gourmards, due to its special flavor and texture. For maintaining and promoting this significant breed of broilers, we tried to investigate the current status of game chicken industry in Hualien-Taitung area. The results showed that because the feed price increased and avian influenza (AI) broken out recently, not only the cost of rearing chickens go up but also increase the risky of import chicks from the west region of Taiwan where is the epidemic area of AI. Besides, the consumption pattern changed, consumers prefer the small-size native chickens than large-size game hens and the market of game hens was affected. Therefore, some farm owners have applied internet marketing to sell their own chickens by themselves, also developed processed products like the condensed chicken soup to increase the profits of broiler farming.

(*C. J. Hsieh and A. K. Su*)



Game hen population in Hualien-Taitung area

The effect of leg health on laying hens rearing condition among battery cages with different density of floor rearing

This study was conducted to investigate that the foot health of laying hens among the cage-rearing and different density of floor pan-rearing. 150 ISA laying hens were divided into A, B and C group randomly. A was battery cage-rearing group, B and C were floor pan-rearing



Foot pad dermatitis of laying hens



Latency-to-lie test

with lower or high density (2.8 m²/bird, 1.4 m²/bird). The test period was from 28 to 48 weeks of age and all hens were floor pan-rearing before 28 weeks old. The egg production was recorded everyday. The scores of foot pad dermatitis (FPD), hock burning damage (HBD) and latency to lie (LTL) were recorded every 10 weeks. Results showed that at the age of 48 weeks, the score of FPD in group A (0.02 ± 0.13) was the lowest than that of in group B (0.63 ± 0.81) and group C (0.58 ± 0.72) significantly (P < 0.05). Moreover, the ratios of FPD were 1.7%, 43.3% and 44.1% in group A, B and C respectively. The scores of LTL were around 2.5 to 2.9 among 3 groups and there were no significant difference among those 3 groups. In conclusion, till 48 weeks of age, the ratios of FPD were over 40% in the floor pan-rearing groups, and no foot health related problem was observed in the cage-rearing group.

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

The effect of biochar on forage production and carbon sequestration

The purpose of this project is to create a low-carbon forage production system for both production improvement and carbon sequestration by field waste derived biochar. The grass biochars used here come from waste pangolagrass (PB). The average value of pH and EC of PB were 9.6 and 5.0 ms/cm. The composition content of carbon, nitrogen, phosphorous, potassium and ash were 64.2%, 1.7%, 2.0%, 3.8% and 12.9%. The average value of iodine and methylene blue were 469.8 mg/g and 15.0 mg/g. The surface area was between 35.2 m²/g to 222 m²/g. From the results

of field incubation, the different conditions created by soil treatments were the main factor to effect on degradation of PB. The amount of PB decomposition was higher on the soil surface than it under the soil. The decomposition rate was not affected by particle size of biochar. The alfalfa growth was improved by application of PB, and the soil carbon and soil organic matter content of treated plots had increasing trend, also. However, fertilization was the main factor to increase pangolagrass growth. Addition of PB had no effect on pangolagrass production.

(S. M. Wang)

The application potential of biochar on poultry litter treatment

The purpose of this project is to improve poultry farmland environment by biochar and to transform poultry litter as useful material. The main outcomes were 1. establishment of a prototype of pyro-equipment for carbonization of poultry litter, and 2. development of a combined deodorant for poultry farming. A one-ton level equipment was established to improvement capacity of poultry litter treatment

and PLB production. The equipment designed in this report was an up-draw gasification type pyrolysis. The charcoal production rate was about twenty percent. Poultry litter biochar produced here had lower carbon content and higher metal content. The surface area of these biochar were among 5-45 m²/g. The iodine number were among 386 mg/g-667 mg/g. The methylene blue number were among 12.7

mg/g-15.9 mg/g. The deodorant developed by combined pangolagrass biochar (PB) and ammonia oxidizing bacteria could reduce 52% ammonia released than control. The de-odor effect of biochar on poultry litter composting was evaluated. The two kinds of biochar used in this project were prepared by Hengchun branch, LRI. The pangola grass biochar (PB) was made by slow pyrolysis and the poultry litter bichar

(PLB) was produced by updraw gasification. Both charcoal production rates were about twenty percent. Addition of PB or PLB with poultry litter could increase the fermentation temperature of compost and decreased the time of compost maturation. The ammonia and trimethyl amine release were improved by biochar addition significantly.

(*S. M. Wang and C. H. Chung*)

The effect of jeans hanging in the pen on dairy goats' daytime behavior

The purpose of this study was to investigate the effect of jeans hanging in the pen on dairy goats' behavior, as a reference to animal welfare and reduce frequencies of self-suckling behavior. Eight Alpine and 3 Nubian goats were used in this trial. Milking were performed at 8:00 and 15:00 and then fed at 9:00 and 16:00. Experiment period was divided into 2 stages. In stage 1 (day1-6), goats were housed in the pen with 4 × 8 m space, and then jeans were hanged in the same pen in stage 2 (day 7-12). Daytime behavior were observed hourly and recorded by scanning sampling method from 08:00 to 17:00. Behaviors of standing/walking, resting, eating, self-suckling, fighting, chewing objects, pawing, and playing jeans were recorded. Results showed that standing/walking, resting, and eating were main behaviors, which took about 92.7-96.4% of overall behaviors. Behaviors of eating increased during feeding time, and the highest peak was

at 9:00. After that, activities decreased and other behaviors increased. The highest peak of rest behavior occurred at 13:00. Standing/walking behavior showed more frequent before milking. In stage 2, behavior of playing jeans took about 5.3% of total behaviors. Jeans hanging in the pen significantly decreased objects-chewing behavior ($P < 0.05$). In addition, jeans hanging increased the frequencies of standing/walking and pawing and decreased resting, eating, self-suckling and fighting. However, these behaviors had no significant difference from that of control group. In conclusion, jeans hanging in the pen attracted goats attention and increased their activities. But it had no apparent effect on negative behavior, such as self-suckling and fighting.

(*I. C. Chou, R. H. Yeh, S. S. Yang, D. C. Wang and J. C. Huang*)



Self-suckling behavior



Hanging jeans in the pen could attract goats' attention

The study of antibacterial dipping agents after milking for control mastitis

The proposed development of new anti-inflammatory dipping agents (complex Chinese herbs), used in dairy cattle teat after milking,

for reducing the somatic cell count (SCC) of cows. They possessed the clear heat and relieve toxicity, varying in their degrees of anti-

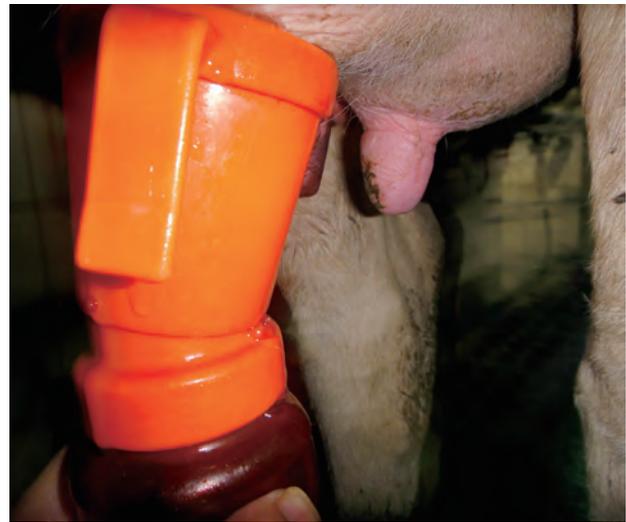
inflammatory and anti-infective actions. These herbs were extracted as dipping form. In trial, there were 40 milking cows were randomly divided into two groups, one was the control group: use Betadine teat dipping agent, another was experimental group: use of compound herbal teat dipping agent. All cows feeding pattern of using the general, with the field test were compared for the same period. Two cows twice daily in the morning and evening are the teat dipping after milking operation, each trial period of two weeks. At start and end of the experiments, we measured the SCC of raw milk. The results showed that cows dipped with compound herbal teat dipping agent (n = 20,

SCC from 32.2 ± 34.8 to $21.4 \pm 18.6 \times 10^4$ cells/mL) better reduced SCC in milk than the control group (n = 20, SCC from 30.8 ± 33.2 to $35.6 \pm 41.5 \times 10^4$ cells/mL) at the end of experiment. From this result showed using anti-inflammatory dipping agents to decrease SCC in raw milk were very potential for dairy industry in the future.

(K. H. Lee, S. H. Wang, Y. H. Chen, J. Y. Chen, J. S. Chao, L. T. Wu and C. L. Chang)



The anti-inflammatory dipping agents (complex Chinese herbs) prepared in dairy teat cup



The anti-inflammatory dipping agents (complex Chinese herbs) used in dairy cattle teat after milking

The innovation of the software about the managerial accounting and the analysis of benefit for the ostrich farms in Taiwan

The study aimed at to guide ostrich farmers accustomed to record their managerial data daily and have the concept of the business administration on their ostrich farms. Based on the recorded data analyzed by computer, the farmers can realize their structure of production cost for ostrich furthermore to seek for the pavement improving managerial efficiency. The character of this software was to analyze the gain or loss on ostrich farms, the comparison of managerial benefits across many years, the expenditure and revenue journal, ledger and double entry. The software for ostrich farms includes many statistical tables as following: the analysis of production cost and revenue per head for different size, region, managerial types on ostrich farms, the analysis of the production cost and revenue per farm on ostrich farm, the table

of fluctuated heads for given time period about ostrich. All in all this software can help farmers to reduce cost without accountant, increase the managerial and profits, furthermore increase the competitive ability for ostrich industries.

(S. Y. Leu)

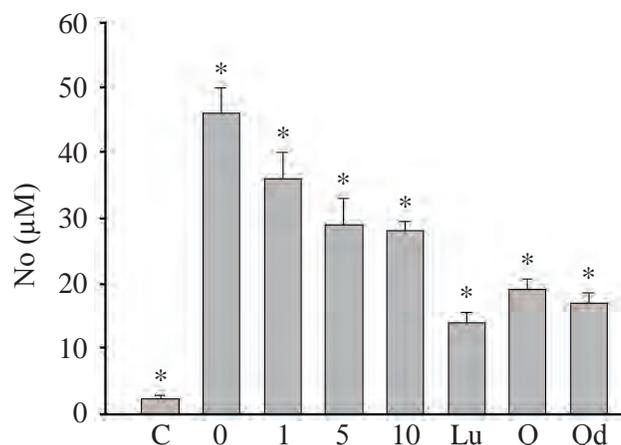


The ostrich farm in Taiwan given guidance on managerially recording accounts

Anti-inflammatory effects of *Taraxacum Mongolicum* extract on lipopolysaccharide-induced inflammatory responses in BV-2 cells

Development of herbal agents that modulate inflammatory mediators in activated macrophages may be a useful strategy for bovine mastitis. To investigate the anti-inflammatory effect of *Taraxacum mongolicum* extract (TME) on lipopolysaccharide (LPS)-induced responses was studied in the murine microglial cell line BV-2. BV-2 cells were pretreated with various concentrations of TME (0, 1, 5, 10 $\mu\text{g}/\text{mL}$) and subsequently incubated with LPS (2 $\mu\text{g}/\text{mL}$). Cell viability was analyzed by 3-(4, 5-dimethylthiazol-2-yl)-2, 5-diphenylthiazolium bromide (MTT) assay. The level of nitric oxide (NO) was determined by using Griess reagent assay. The levels of prostaglandin (PG) E_2 and pro-inflammatory cytokines including interleukin (IL)- 1β , IL-6 were analyzed by enzyme-linked immunosorbent assays. The results showed no significantly cytotoxic effects on the BV-2 cells at various treated concentrations of TME. Treatment of TME (1, 5, 10 $\mu\text{g}/\text{mL}$) significantly inhibited NO production in LPS-stimulated BV-2 cells ($P < 0.01$). TME (10 $\mu\text{g}/\text{mL}$) significantly inhibited LPS-stimulated significantly inhibited LPS-stimulated PGE_2 , IL- 1β and IL-6 production in BV-2 cells ($P < 0.01$). Taken together, the anti-inflammatory effects of TME are probably due to down-regulation of NO, PGE_2 , IL- 1β and IL-6.

(K. H. Lee)



Effect of *Taraxacum mongolicum* extract (TME) and antioxidants on nitric oxide (NO) production in LPS-stimulated BV-2 cells. BV-2 cells were treated with the indicated concentrations of TME or antioxidants (Lu: Luteolin, 5 μM ; Q: Quercetin, 5 μM ; Qd: Quercetin dehydrate, 5 μM) and treated with LPS (2 $\mu\text{g}/\text{mL}$) for 24 hours. The release of NO was measured by Griess reaction in the culture supernatant. Data are mean \pm SEM values of three individual experiments.

* $P < 0.05$, significant difference from the LPS control group.

The profit analysis of the managerial accounting for the dairy goat farmers in Taiwan

The study was based on the managerially recording accounts on the 6 dairy goat farms (Oct.2012-Sep.2013). The total production cost per head one year was NT\$ 2,083.77 including the direct cost NT\$ 17,174.71 and indirect



The dairy goat farm in Taiwan was given guidance on managerially recording accounts

cost NT\$ 3,204.90. The main components of the production cost were feeds (57.10%), labor (19.04%), the depreciation cost of ewe (7.58%). The net revenue was NT\$ 901.47 per head of the dairy goat for one year. The main stream of the revenue was the goat milk, others including the sale of goats, the sale of manure of goats, the fluctuation of stock value. The goat farmers raised dairy goat about 428.65 heads on feeding and meat goat about 34.26 heads on feeding averagely. The goat farmer can get net revenue about NT\$ 420,824 per farm including dairy goats and meat goats. If the home labor estimates was excluded from the total costs, they

can get farm earnings per dairy goat farm about NT\$ 1,136,840.94. The net cost of excluding by-products per kg of goat milk was NT\$ 35.17. The managerial efficiency of the dairy goat farm at the middle Taiwan was less than that at the southern Taiwan. The managerial efficiency of the dairy goat farms on feeding 200-400 heads was less than that on feeding 401-700 heads. Not only the production of milking goats, but also

the ratio of milking goats were the important factors affecting the managerial profits. But the factor of the production of milking goats was greatly more than the factor of the ratio of milking goats. In order to increase the managerial profits, the dairy goat farms at the middle Taiwan can enhance the pure technique efficiency.

(S. Y. Leu)

The analysis of the managerial accounting and benefit on the ostrich in Taiwan

The study aimed at analyzing the production structure and the managerial profits on the ostrich farms in Taiwan. Based on managerially recording accounts from Sep. 2013 to Aug. 2014 on the 8 ostrich farms, the analyzed results were as followings. The gross production cost one year was NT\$ 11,586.87 per bird. The main components of the cost structure were feed cost (39.01%), labor cost (26.74%), the electricity cost (4.16%). The direct cost per bird of ostrich was NT\$ 9,525.91 (82.2%) one year, and indirect cost was NT\$ 1,778.25 (15.35%) per bird. Most of ostrich farms have been closed because they mainly sold the lived ostrich but got loss. The net revenue per bird of ostrich was NT\$ -659.8 under the price NT\$ 120/kg and lived weight 93.64 kg/bird. If the home labor was excluded from the production cost, the farm earnings was NT\$ 2,104.7. Comparison of two

managerial types, if the ostrich farmers produce and directly sell it to consumers, the net revenue and farm earnings per bird were NT\$ 332.64, NT\$ 2,560.96 respectively. Oppositely the ostrich farmers sold them with lived ostriches, the net revenue and farm earnings were NT\$ -1,652.34, NT\$ 1,648.52 respectively. The factor of affecting the managerial profits is increasing the value added of processing. The farm size more than 100 birds is suggested. The present problem of ostrich farmers' suffering are as following: low livability and hatchability, no public slaughter house, lacking of processing hide of birds. In future, we should increase government's subsidy, emphasize and advertise the property of the meat for ostriches, rise the livability and hatchability.

(S. Y. Leu)

The analysis of the consumer's behavior and marketing channel for the domestic goat meat in Taiwan

The aim of the study was to make the survey of consumer's character for the domestic goat meat and marketing channel. According to the surveyed data of the 63 samples, the analyzed result was as following. The consumer's behavior for the domestic goat meat were classified into two types. One is the man directly consumed at specialized store, the other is the man to buy the domestic goat meat and cooked at home. The consumer's mostly emphasized the freshness (90.5%) of the fresh goat meat, secondly was the food security (46.0%). Almost of the consumers do not select the special brand of domestic goat meat (95.2%). Most of the consumers bought the domestic goat meat at

the traditional market (52.4%), secondly at the specialized store of goat meats (41.3%). Most of the consumers bought the goat meat at the commodity case (54%), others bought them by their relation and friends (50.8%) offering news. How to retain the freshness of goat meat is the main inducement (79.4%) to buy the goat meat at the same store. The second inducement (69.8%) was the reasonable price. There is no offensive smell is the most important factor to attract the consumers eating domestic goat meat (66.7%). The most important factors affecting consumers to buy goat meat included the origin, price, clear brand of the domestic goat meat. As the result, if we want to enlarge the domestic

goat meat market, the producers must castrate for young male goat. The retailers must make the work of retaining the freshness of goat meat.

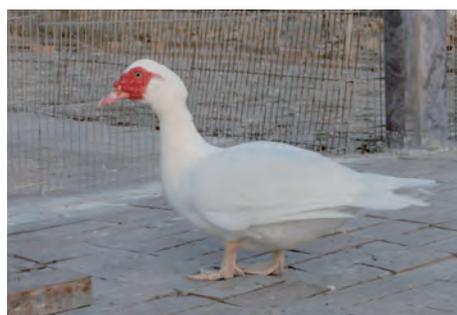
Our government can popularize tasting the domestic goat meat to enlarge the local market. (S. Y. Leu)

The effects of breeding density on growth and carcass traits in male Muscovy duck

The aim of this experiment was to investigate the effects of breeding density on growth and carcass traits in male Muscovy duck, expecting to set up a standard for feeding male Muscovy. Ducklings were bred in brooding duck house from hatched to 2 weeks of age and allocated into four feeding density (0.5, 0.8, 1.1 and 1.4 duck/m², respectively) randomly. Each treatment contained three pens as replicates and total of 12 pens were used in the experiment. Male Muscovy duckling were produced at Ilan Branch, LRI. Diets of brooding stage (CP 20%, ME 3,000 kcal/kg), grower stage (CP 15.5%, ME 2,750 kcal/kg) and finisher stage (CP 17%, ME 2,800 kcal/kg) were self-made. Natural ventilation and lighting was adopted in the experiment, feed and water were given *ad libitum*. In addition to nipple drinkers, a water trough was given also in each experiment pen. Growth traits, feather growth situation and environment parameters inside and outside the duck house were determined in the experiment. Ducks were sacrificed at 16 weeks of age for carcass characteristics and meat qualities determination. The results indicated that the average temperature and humidity in the duck house was 30.7°C and 71.3%. In the body weights, duck bred in the duck house with density of 0.5/m² showed significant higher body weight of 3,633 g than treatments with densities 1.1 and 1.4/m² 3,455 and 3,459 g respectively ($P < 0.05$). However, at 16 weeks of age, the body weights in all treatments were between 5,280 to 5,474 g and no significant difference among treatments. In the feed intake, the average daily feed intake

from 3 to 16 weeks of age of all treatments were in the range of 197 to 201 g/day/bird and no significant difference among treatments. The cumulative feed conversion ratio from 3 to 16 weeks of age were between the range 3.80 to 3.92 and no significant difference among treatments. In the length of major feather, the length were between the range of 28.23 to 30.20 cm and no significant difference among treatments. In the carcass traits, the carcass yield of all treatments at 16 weeks of age were between 81.0 to 82.1 and no significant difference among treatments also no significant difference in the results of approximate chemical composition and sensory scores of breast meat among treatments observed. From the results of this experiment, it is recommended to breed male Muscovy ducks with density of 1.4 duck/m² if commercial property was concerned. However, to breed Muscovy drakes with density of 0.8 duck/m² is recommended when animal welfare, body weight and feed conversion ratio are also considered.

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



Male Muscovy duck

Establishment of production model in turkeys. 2. Effect of stocking density on growth performance of meat-type turkeys

The study was to investigate the effect of stocking density on growth performance, footpad dermatitis (FPD) score and dressing percentage (DP) of meat-type turkeys. One hundred and sixty B.U.T. 6 commercial birds were purchased

from a commercial hatchery at 10 days of age. The turkeys were randomly allotted into 8 pens in each gender. The data showed that body weight (BW) and feed intake (FI) was significantly higher ($P < 0.001$) and weight gain (WG)

and feed conversion rate (FCR) was significantly better ($P < 0.001$) in male turkeys than those of females. No significant effect of stocking density from 16.9 to 27.8 kg/m² on BW, FI, WG, and FCR of male turkeys in 68 to 150 days of age were observed. Moreover, FPD score and DP of turkey toms were not significantly affected by the present stocking density. There was a regressive relation between the stocking density and the FCR in this experimental period. The regression equation was $y = 0.0381x + 2.3798$, $t = 3.10$, $P = 0.0113$. Another aspect, no significant effect of stocking density from 17.3 to 29.3 kg/m² on BW, FI, WG and FCR of female turkeys in 68 to 129 days of age were observed.

FPD score and DP of turkey poults were also not significantly affected by the present stocking density. There was a regressive relation between the stocking density and the FCR in the feeding duration from 87 to 102 days of age. The regression equation was $y = 0.0570x + 2.7060$, $t = 2.64$, $P = 0.0247$. Under the present experimental conditions, we concluded that the growth performance of meat-type turkeys was affected by sex. Meanwhile, the higher stocking density, which was 16.9 to 27.8 kg/m² in male and 17.3 to 29.7 kg/m² in female, the poor feed conversion rate was observed.

(S. D. Wang)

Effects of light-emitting diode illumination and lighting regime on laying performance in geese

The objective of this study was to investigate the effects of different light-emitting diode (LED) illumination and lighting regime on laying performances in geese. A 2 × 2 factorial design was used to evaluate the cross interaction between LED illumination of white and red and lighting regime of fixed and changed. Thirty-two gander and ninety-six female White Roman geese at age of first parity were randomly allotted into 4 treatments. There were 2 pens in both treatments, 4 ganders and 12 geese in each pen. The geese were reared in the environmentally controlled geese house after productive regulation. After the length of photoperiod about 7 h of light per day (7L:17D) for 6 weeks, it adjusted the length of photoperiod to 9 h of light per day (9L:15D). The treatment of changed lighting regime were going to increase 15 minutes of light every two weeks until a regime of the length of photoperiod about

11 h of light per day (11L:13D) and maintained to the end of laying. The feed and water were offered *ad libitum* during the experimental period. The eggs were collected twice a day and incubated every two weeks, recording the numbers of egg production, fertile eggs and hatched gosling to do data analysis. The results showed that there were no cross interactions between LED illumination and lighting regime on egg production, fertility rate, hatchability of fertile eggs and hatchability. The lighting regime had no significant effects on egg production, fertility rate, hatchability of fertile eggs and hatchability. The LED illumination of red showed higher fertility rate and hatchability than white illumination (79.1% vs. 73.4%, 70.1% vs. 64.7%; $P < 0.01$). In conclusion, the red LED illumination could improve the fertility rate and hatchability in geese.

(S. C. Liao, S. C. Chang, M. J. Lin and Y. S. Jea)

A study of RFID technology for selecting and breeding in breeder geese

This study was to investigate the laying habit and floor egg during laying period in geese house. A total of 80 geese (20 ganders and 60 geese) with the 1st lay, were allotted into geese house. Each pen set up a RFID device (a laying cage and a monitor) to collect egg-laying data. The results showed that the floor egg was 20-25% in this experiment. The body weight of male and female at the beginning of the

experiment were 4.31 and 3.69 kg respectively.



The laying cage of RFID in breed geese

The body weight of male and female at sexual maturity were 5.62 and 5.53 kg respectively. The fertility and fertilization of hatchability were 52.8% and 86.5% respectively. This experiment was finished in cage design and preliminary

software design in floor geese house. So far, the device could detect geese in pen, and catch the egg information through artificial rolling-egg test.

(*S. C. Chang, M. J. Lin and S. C. Liao*)

Enhance the quality and quantity of geese down

The development for the down and feather industry has started from the beginning of 19th



The feeding of geese in environmental house

century. Due to the increasing demand for the feather products, the developing space of feather market is gradually expanding. The down from geese are used as high-grade insulation material in both clothing and bedding. The purpose of the study was to evaluate the method of feeding management in order to enhance the quality and quantity of geese down. The results indicated that the percentage of down to feather ratio in environmental house and traditional house were 92.6% and 62.8%, respectively. Base on above results, we needed to find more effective method to harvest the better quality down in traditional house.

(*M. J. Lin and S. C. Chang*)

Improvement of biosecurity of geese farm

The purpose of this study was to improve the biosecurity of geese farm and conserve breed of geese. An isolating breeding area includes three un-open-sided geese house which separates from other rearing area were set up. The area contained the buffer area to practice a strict access control for people and goods to decrease the risk of cross contamination. The reserved

geese were sampled randomly eight times to monitor the health condition and all geese are three times before the begging of reproductive season. All the test results for all geese were free of AIV nucleic acid.

(*S. C. Liao, C. M Wang, S. C. Chang, M. J. Lin and Y. S. Jea*)

Establish the system of circumstance monitoring for premium livestock production

The aim of this study is to find out a suitable combination of RFID (radio frequency identification) technique and genetic selection for commercial breeder. A total of 120 geese (30 ganders and 90 geese), breeder chicken and 48 ducks (8 males and 40 females), were allotted into poultry house respectively. This experiment installed RFID device of the pen to collect egg-laying data. The results showed that the ratio of floor egg was 23.1% and 76.9% of eggs laid in nest in geese. The accurate rate of egg identification for the system was 63%. The data in breeder chicken egg's weight could go back to data bank was 100% accurately. The chicken



The equipment of imaging monitor of laying cage of RFID in breed geese

egg which stuck barcode at the middle position had the highest hatchability (90.2%). The electronic label in duck's body within 30 cm could be read by the sensor in nest to identify whether the

duck was laying or not.

(S. C. Chang, P. H. Chuang, C. H. Cheng, T. Y. Lin, A. K. Su and H. C. Liu)

The design and application of intelligent management goose house for breeder

This study was to set up a breeder geese house of intelligently managerial model including the systems of feeding, drinking, lighting, fan, negative pressure and environmental monitor. The length and width of the intelligently managerial goose house built up by the industry-academy cooperator were 96.45 and 19.86 m, individually. The height of the eaves and depth of basement were 3.10 m and 90 cm, separately. The roof was composed with H type of steel (500 mm × 200 mm and 400 mm × 200 mm). The height of the silo was 6.50 m and its material quality was FRP (Fiber-reinforced plastic). The width and height of kneeboard surrounding with the goose house were 20 cm and 70 cm, respectively. This intelligently managerial goose used

LED (Light-emitting diode) lamps and transparent canvas, cooperating with the natural illumination in order to increase the illumination intensity and delay the beak portion of goose turned white situation. When combine the equipment of environmental monitor in the internal environment, it can raise one kind of goose's environmental materials effectively. The breeder geese will be arranged to the goose house next year and they will be regulated in the laying period. Besides, the electric power and feeding data (likely performance expression) could be collected in this kind of house in this intelligently managerial geese house.

(S. C. Chang, M. J. Lin, C. Liao and T. Y. Lin)



The building engineering of intelligent management goose house for breeder

Forage Crops

The study of pangolagrass pasture improvement

The objective of this study was to determine the efficacy of improving methods for perennial pangolagrass (*Digitaria decumbens* Stent.) pasture grown more than 10 years. The different cultured methods including discontinued and continued improvement will test on next year. The efficient of recovering the forage yield, quality and soil fertility was evaluated after different treatments i.e., control (CK), organic fertilizer (800 kg/ha) with rotary cultivator (OFRC), rotary cultivator 1,600 rpm (RC), soybean (*Glycine max*) (80 kg/ha) with rotary cultivator (SRC) and sun hemp (*Crotalaria juncea* L.) (40 kg/ha) with rotary cultivator (SHRC). Experiment field was designed with randomized completely block design (RCBD) and three repetitions. The results showed that the plant chemical contents of SRC

or SHRC have higher crude protein than other treatments. Soil contents of treatments were not significantly different among all treatments. The yields of SRC treatment of discontinued improvement produced the highest forage yield of total seven harvests was 54.89 ton/ha among all treatments, and followed by SHRC treatment was 54.05 ton/ha. The highest net income was NT\$ 146,592 on SRC among all treatments of discontinued improvement. SHRC treatment had highest yield 54.81 ton/ha among all treatments on continued treatment, but the highest net income was NT\$ 147,616 of CK treatment. Considering the net income, it might be suggested farmers employ the SRC treatment to pangolagrass pasture improvement.

(J. B. Lin, S. R. Chang, T. R. Li and C. H. Lu)

Breeding of Napiergrass (*Pennisetum purpureum*) Taishi No.4

Napiergrass (*Pennisetum purpureum*) line 8810 is one of the progeny of Taishi No.2 crossed with the native purpleum napiergrass (NPM). Which was selected serval after different testings i.e., regional trial, fertilizer trial, production and management trial and ensiling trial, respectively. The results showed that of the line 8810 had much higher forage yield as compared to NPcv.TS2. Results of the fertilizer trial showed that line 8810 had higher crude protein (CP) at 1,000 kg/ha nitrogenous level than that of the 600 kg/ha. However, no significant different were observed on acid

detergent fiber (ADF) and neutral detergent fiber (NDF) content. Result of the management trial suggested that forage yield was highest at row distance of 100 cm. CP content decreased significant as the cutting period prolonged. On the contrary, content of ADF and NDF increased as the cutting period prolonged. Flieg's score of ensiled 8810 reached as 88 points results showed at ensiling trial. After evaluated entirely by the results above, line 8810 was named Napiergrass Taishi No.4 on June 2010.

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

Study on enriching the carbon stock of perennial pasture by forage management

The objective of this study was to reduce the nitrogenous (N) fertilizer applied and enrich the soil carbon stock of perennial pasture by forage management. The soil carbon (C) stock above 30 cm of soil planted pangolagrass and napiergrass were less than 30 ton/ha. The bulk densities of soils of pangolagrass and napiergrass were more than 1.30 g/cm³. It was

showed that of the soil was compacted by machine operating in the pasture for many years. The forage yields of napiergrass intercropped with the green manure or applied the cattle manure, due to provide the relatively slow fertilizers, were slightly lower than that of applying chemical fertilizer (CK). The forage yields index of CK was 100%, then the index of

napierrgrass Taishi No.2 and napierrgrass Taishi No.3 intercropped with the green manure or applied the cattle manure, were approximately 83-89%. The soils with green manure or cattle manure on soil organic matter, total nitrogen, available P, exchangeable K and Mg were higher than those of CK treatments. The results were

showed those of the napierrgrass intercropped green manure or applied cattle manure might be appropriate to reduce the amount of nitrogen fertilizer applied, without a lot of influence the forage production.

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

Effects of intercropping manure crop on the production and fertilization of napierrgrass pasture

The objective of this study was to evaluate the intercropping of manure crops such as, sesbania (*Sesbania roxburghii*) or manure soybean (*Glycine max*) with napierrgrass (*Pennisetum purpureum*) on the productivity of napierrgrass and soil fertilization of pasture. Manure crops will be planted and intercropped with napierrgrass. Forage yields, chemical components of forages and characters of soil will determined during harvesting. The results showed those of the soil characters, including pH and contents of organic matter were obvious change observed after rotation-cropping, especially. The effects of rotation with manure crops on forage yield was also obviously change of obeseration.

(S. R. Chang, C. H. Lu and J. B. Lin)

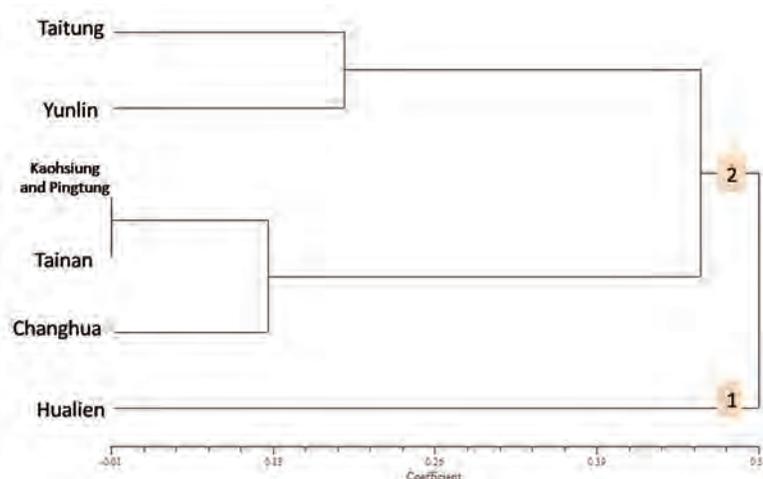


The intercropping of napierrgrass with sesbania (*Sesbania roxburghii*)

Collection and preservation of forage germplasm-collection and evaluation of kudzu and velvet bean in Taiwan

It is important to find out alternative legume forage to provide the protein ingredient. Velvet bean (*Mucuna pruriens*) is a widely available leguminous crop, which grow well in tropical, subtropical and temperate regions. Kudzu (*Pueraria spp.*) and velvet bean are grown as a green manure or cover crop in Taiwan. In

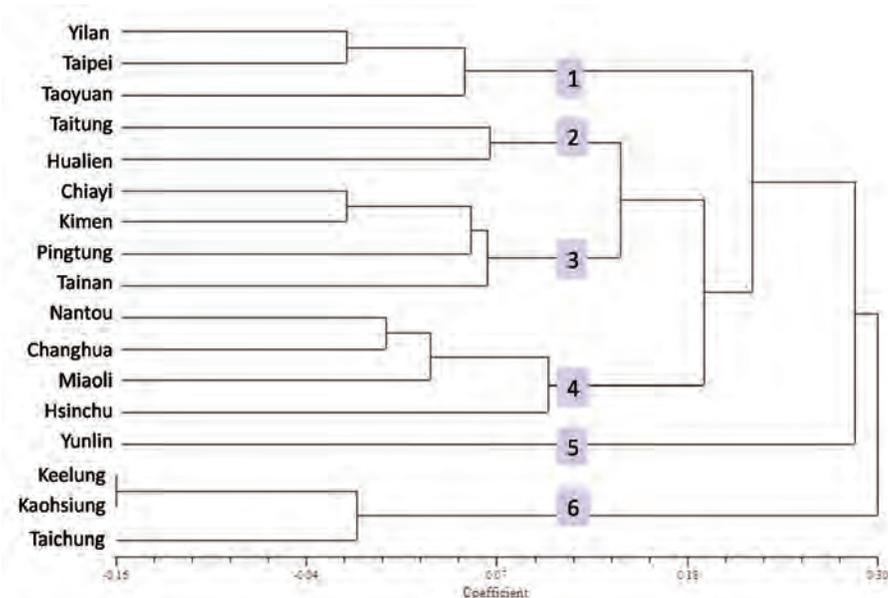
this study, we collected 91 samplings of *Pueraria* spp. and 30 samplings of *Mucuna pruriens* from 16 counties of Taiwan, attitude of collection are from -4 to 1,216 meter height. The seed-coat color of velvet bean samplings including involve off-white and brindle. The genetic diversity was determined by moleculer biotechnique



UPGMA cluster analysis of velet bean in Taiwan

and cluster analysis. All samples by PCR amplification with ISSR primer. The UPGMA cluster analysis and principal coordinate analysis showed those of the velvet bean and kuduz samplings could be divided into two

and six groups, respectively. The results might be provide informations for forage germplasm database and researchers using. (T. R. Li and J. B. Lin)



UPGMA cluster analysis of kuduz in Taiwan

Effects of BA and CPPU on callus induction and plant regeneration of digitgrass 'Survenola'

The objective of this study was to develop an efficient plant regeneration system from immature inflorescences of digitgrass (*Digitaria × umfolozi* Hall) var. 'Survenola'. Explants were cultured in MS medium supplemented with 2,4-D, BA and CPPU medical preparations. The effects of BA and CPPU on callus induction frequency and morphology would be examined. The frequency of white and compact callus induced was 90.0% with BA and 70.0% with

CPPU supplied, respectively. Calli induced with BA and CPPU were cultured on MS medium supplemented with TDZ 0.05 mg L⁻¹. The plant regenerated frequency of callus induced with 2,4-D 2.0 mg L⁻¹ and BA 1.0 mg L⁻¹ was 45.0% and CPPU 1.0 mg L⁻¹ was 35.0%, respectively. The optimal medium for callus induction was 2,4-D 2 mg L⁻¹ with BA 1.0 mg L⁻¹ and plant regenerated with TDZ 0.05 mg L⁻¹. The tissue culture system for plant regeneration of digitgrass 'Survenola' might be useful for mass propagation and variety reserve studied. (Y. M. Shy)



Mass production of digitgrass 'Survenola' by tissue culture grow vigorously 4 weeks after transplanted into field



Plant regeneration with 0.05 mg L⁻¹ TDZ from the white and compact callus induced with 2,4-D 2 mg L⁻¹ and BA 1.0 mg L⁻¹ of digitgrass 'Survenola'

Evaluation on spatial pattern and harvest time of intercropped forage corn and soybean in different crop seasons

Forage corn and soybean intercropping is the alternative to reduce the reliance on imported forage legumes, but the ideal spatial pattern and harvest time of this cropping system are still unknown in Taiwan. The study was conducted to determine the spatial pattern and harvest time in spring and fall by the maturity of forage corn (1/4, 1/2 and 3/4 milk line stage). According to yield per hectare and forage nutrients analysis, it indicated that dry matter and crude protein yield of 3/4 milk line stage is the highest in spring crop season, and the ideal spatial pattern is corn : soybean in alternate-row

strips with two rows (2C:2S), which showed higher dry matter and crude protein yield than corn:soybean in alternate-row strips with four rows (4C:4S). 2C:2S is also the ideal spatial pattern of intercropped forage corn and soybean in fall crop season. However, dry matter and crude protein yield of 1/4 milk line stage is the highest in fall crop season. To acquire higher forage yield and quality of intercropped forage corn and soybean, it is clearer to determine the spatial pattern and harvest time in spring and fall crop seasons by this experimental result. (M. H. Chu, S. M. Wang and C. S. Chen)

Calibration equations establishment of near-infrared spectroscopy and silage quality analysis for forage corn and soybean intercropping

To rapidly analyze the quality of silage, the study was conducted to establish the calibration equations of near-infrared spectroscopy for forage corn and soybean intercropping. The established NIR calibration equation is widely acceptable by exploiting diverse cropping seasons, harvest maturity, forage and silage samples. The standard error of cross validation (SECV) for crude protein, acid detergent fiber and neutral detergent fiber were 0.81, 1.07 and 1.29%, the standard error of calibration (SEC) were 0.64, 0.83 and 1.08% and the regression coefficients (R^2) were 0.91, 0.92 and 0.93, respectively. It indicated that these three calibration equations were sufficiently accurate for predicting the nutrient constituents. Based on silage quality analysis of different intercropping

treatments, the pH value, lactate and acetate yield of intercropped silage could reach steady state after 14 and 90 days storage, respectively. The pH value of soybean silage is the highest (pH 5.6) and the value of intercropping silage is close to corn silage (pH 4.0). The content of lactate for intercropping silage is close to corn silage but significantly higher than soybean silage. Soybean silage showed significantly higher acetate content than intercropping and corn silage. Besides, all intercropping silage could reach the similar quality to corn silage (Flieg's point > 80). Both in spring and fall crop season, the 1/2 milk line stage of corn is the better ensiled time for forage corn and soybean intercropping. (M. H. Chu, S. M. Wang and C. S. Chen)

Effects of Cd on the activity and gene expression of peroxidase isozymes in various *Oryza sativa* Cultivars

Plant class III peroxidases are present in all land plants and form large multigenic family. These multigenic families originate from gene duplication events. All land plant peroxidase genes are with the same putative ancestor of peroxidase genes and are orthologous genes. These peroxidases have specific physiological functions of individual peroxidase genes owing to their promoter sequences are very divergent. In

this work, 6 Arabidopsis Cd-related peroxidases protein sequences were as the template for blasting rice peroxidase information. 9 rice peroxidase genes were blasted from 138 rice peroxidases, and they have a very closely relation among them. The 9 rice peroxidase genes are not distributedly present in rice chromosome III and VII, divided into 2 clusters. Two genes Os03g22020 and Os07g48060 are in

the same cluster, and another cluster included 7 genes, Os03g22010, Os07g47990, Os07g48010, Os07g48020, Os07g48030, Os07g48040 and Os07g48050. To understand more details about these rice peroxidase genes, searching each one of its gene structure on the Rice Genome Annotation Project (RGAP), comparing the differences among their genes structure and phylogenetic tree relation. The activities and

gene expressions of peroxidase genes were compared. The results showed that of the activities change and gene expressions were very different in both roots and stems during seedling among them by Cd treatment and without Cd treatments in various rice cultivars (japonica and indica type).

(M. L. Chang, L. J. Liao and Z. H. Liu)

Research on short-term forage production in summer-mixed cropping of forage corn and sorghum

Forage corn is the most important local forage crop in Taiwan, but it suffers rain damage and can't be planted smoothly due to continuous rainfall in summer. The shortage of forage resources from May to October is a problem to be solved. The possibility of mixed planting of the production of two species in spring and harvesting twice till summer to provide summer green fodder is worthy examined. The cultivation method, productivity potential and quality change will be investigated in this study, and to establish the mixed cropping model. The results showed that there were many significant differences in growth characters, especially the most obvious difference in fresh weight between forage corn and tiller type sorghum crops in the middle and late periods in March and April

of spring crop. In forage corn and tiller type sorghum mixed cropping model, forage corn had better growth than tiller type sorghum in March. The main production of forage corn and tiller type sorghum mixed model were both the highest among other crops in March and April of spring crop. There were no plants occurred lodging, pest and disease during spring crop, showed the cross-protection effect was obvious between forage corn and tiller type sorghum crops. In ration harvest, both forage corn and tiller type sorghum mixed model had the max productions than single tiller type sorghum and the total production was forage corn and tiller type sorghum mixed model in spring crop.

(M. L. Chang, S. M. Wang and C. S. Chen)

Research Projects in Progress

Animal Breeding and Genetics

1. The study on technical networking and industrial usage of livestock germplasm
2. The establishment of production model for black hair hog (I)-the reciprocal crossing of TLRI Black Pig No. 1 and KHAPS Black Pig
3. The breeding of prolific black pigs with HH6 haplotype of H-FABP gene
4. Selection and breeding of silky chickens with blue shell eggs
5. Development of micropig genetic resources
6. Improvement of pig breeding and production
7. Assessment of introduction of Taiwan Yellow Cattle in Peng-Hu
8. Utilization and cryo-banking for animal genetic resources
9. Comparison of genetic diversity between conserved populations and economic traits selection populations of ducks
10. Genetic diversity maintenance and application of Taiwan Yellow Cattle and Taiwan Black Goat
11. Utilization in geese and swan
12. Management and genetic diversity maintenance on homozygous genotypes chickens
13. The maintenance and utilization of Taiwan buffalo genetic diversity
14. The study of the gene diversity of game chickens
15. Conservation and utilization of indigenous minipig's genetic resource
16. Construction of buildings for dispersal conservation and monitoring of genetic background in biomedical minipigs
2. Nutrition strategy on relieving the high somatic cell count in Holstein cow milk due to climate change-vitamin and mineral
3. Enhancing herbivores reproduction, production performance and livability of feeding and management techniques
4. Study of relationship among content of raw milk free fatty acid, milk quality and shelf life of fresh milk
5. Effect of dietary crude protein concentration and limited or unlimited fed on the growth and carcass performance of indigenous miniature pigs
6. Application of edible fungus fermented rice straw in goat diet
7. The study of organic multi-feedstuff applications in dairy cattles-the Pangola grass cultivation of mushroom with polysaccharides
8. Estimate the fallow land of *Leucaena leucocephala* for goat feeding
9. Improvement of poultry breeding and production techniques
10. Determination of arsenic species in feeds by HPLC-ICP
11. The study of nutritional requirement and establishment of characteristic feeding system on Duroc x KHAPS black pigs
12. The effect of increasing fiber in late stage gestation diet on gestating and lactating performance of first parity sow
13. Effect of heat-tolerant *Bacillus coagulans* on the L-lactic acid production in solid-state fermentation of wheat bran and defatted rice bran
14. Establishment of microencapsulation technology of enzymes and probiotics used in animal feed
15. Effect of supplementation of mushroom by-product in diets on the growth performance and immune response of dairy goat kids
16. The study of organic resources treated by black soldier fly recycling technology
17. Exploration of animal and plant alternative feed resources for livestock in Taiwan

Animal Nutrition

1. Effects of dietary supplementation of calcium and by-pass amino acids on antlers production and blood biochemical values in Formosan sambar deer

18. The study of organic multi-feedstuff applications in dairy cattle - carrot pomace
19. Establishment of minipigs nutrition requirement and feed supply system

Animal Physiology

1. Evaluation of caprine POU1f1 gene and their associations with growth traits of Nubian goat
2. Study on the cryopreservation method of swine semen
3. Holstein bull semen production and storage
4. Improvement of the feed resources exploitation, utilization efficiency and analyses capability
5. Establishment of chicken induced pluripotent stem cells
6. Transplantation study of porcine induced pluripotent stem cells. II. In the rat model of osteoporosis
7. Study of sex-determining gene in chicken embryo
8. Study on cryopreservation and quality analysis of bovine embryo

Processing of Animal Products

1. Extracts of fresh or dried spices replace partly nitrite for developing meat products
2. Study on the manufacture of seasoning sauce by fermentation using salted duck egg white
3. Development of jerky product with low sugar content
4. Study of the differences of velvet antler quality and performance characteristics between local and imported velvet antler
5. Studies on functional compounds and bioactivities of local goat milk on intestinal health
6. Effect of replacing pork backfat with vegetable on fatty acid composition and quality of sausages
7. The development and products application of oil powder technology
8. Development of native flavor cheese
9. Isolation and characterization of milk fat globule membrane

Livestock Management

1. Establishment of agricultural innovation incubation network and service power upgrade
2. Study of herbaceous plant to promote the efficacy of immunity and growth performance on nursery pigs
3. Reduction of the livestock waste and promotion on the efficiency of wastewater treatment
4. Hoof health management of Holstein dairy cattle under hot and humid environment
5. Rectification of self-suckling behavior in lactating does
6. Association of gene polymorphism with yield of velvet antler in deer
7. Progesterone supplementation post artificial insemination to improve fertility of Holstein cows during the hot season
8. The effects of postpartum uterine involution in dairy cows by using herbs
9. Development of the integrated technology on wastewater treatment for water-saving livestock production
10. The development of feeding and management system for dairy farm
11. Enhancing functional examination of milking machine to improve milk quality
12. The research of functional additives in milk replacer for goat kids
13. Improvement of biosecurity of geese farm
14. Establishment of the mule duck production model with biosecurity, labor-saving and animal welfare
15. Value-added technology development and application of food animal breeding stocks industries
16. Preservation and restoration of precious chicken
17. The research of the growth performance and feed efficiency of young ostriches
18. The effects of LED illumination on the laying performance of waterfowl
19. The carbon footprint of domestic dairy production evaluated by life-cycle assessment
20. Development of technology for nutrient removal and reducing greenhouse gas with algae in the livestock wastewater

21. Study of the optimal dewater and drying techniques for livestock manure
22. Recycling and improving wastewater quality of dairy cattle
23. Recovery and reuse of phosphorus from livestock wastewater treatment system
24. Promotion of reproductive technique for breeding system and improvement on heat tolerant traits of breeds in farm animals
25. The evaluation of irrigation of livestock anaerobic wastewater at the pasture area
26. Research and development of activated sludge liquid desulfurization technology
27. Technology in farm animals manure co-digestion and its products utilization
28. Technology on anaerobic sludge treatment of livestock wastewater
29. The treatment and reuse of wastewater from water saving feeding model of pigs
30. Goose house wastewater treatment and its recycle
31. Assessment of wastewater treatment and recycling in indoor duck house
32. The applications of sexing semen in breeding stock industry
33. Research on poultry breeding eggs disinfection, hatchability enhancement technology and shipping boxes quality
34. Development of novel technology for semen conservation and transportation of breeding stocks in animal industry
35. Monitoring of DNA barcodes of breeding cattle in breeding cattle farms-genotyping of CVM and BS
36. FABRC-Screening of meat quality gene for pedigree registered breeding stocks in livestock and poultry breeds
37. Genetic diversity analysis and banking of tissues and cells of livestock germplasm
38. Application of flow cytometer to evaluation of sperm maturity in breeding pig of the pig performance testing station
39. The effect of maternal inheritance on the thermotolerance of pigs derived from different hybrids
40. Food Animal Breeding Research Consortium (FABRC): Selection and application of high feed efficiency in brown Tsaiya duck
41. Food Animal Breeding Research Consortium (FABRC): Selection for high egg production line in white Roman goose
42. Screening and elimination sperm with fragmentary chromatin from young breeding boar and rooster
43. Establish high reproductive efficiency breeding platform in chicken-selection on high fertility rate and high hatchability
44. Development of bioreactor, artificial reproduction and biomedicine animal model technology in livestock
45. Selection of heat-resistant breed of goat
46. Food Animal Breeding Research Consortium (FABRC): Establishment of sexing reproduction system in Formosan sambar deer
47. Innovation technology for performance evaluation and reproduction of breeding stocks in animal industry
48. Improving the aggressive behaviour of grouping pigs by enriched environment
49. The enhanced supply and quality improvement for chicken with minimum disease
50. Optimization on health quality of minipig core population
51. Minimal disease livestock and avian for biomedical material supply and equipment development
52. Establishment of rabbit supply system for biomedical research
53. Maintenance of genetic resources in another place and screening for minimal diseases geese
54. The application of new waterfowl experimental house on production of Muscovy duck with minimal disease
55. Promoting industrialization of laboratory miniature pig and constructing knowledge services platform
56. Industrialization of minipig and poultry egg production
57. Study the therapy of porcine induced pluripotent stem cells in osteoporosis model of Lanyu pigs
58. Establishing industrialized model of Muscovy duck production for biomedical purposes
59. Set up a business production model for biomedical goose

60. Remote population amplification of miniature pigs for multiple biomedical researches
61. The use of genetically modified to achieve the purpose of miniaturized medical students Lanyu pig
62. The study of dairy records management system and DHI information for dairy farm precision in United States
63. Study on Technology Development of International Committee for Animal Recording (ICAR)
64. Breeding stocks from Taiwan for animal industry in Southeast Asian countries with cooperation program
65. Invitation of US dairy expert on genome selection
66. Introduction of high lactating performance of French Alpine goat
67. Development of the technology for improving quality of livestock wastewater
68. Taiwan and France laboratory miniature pig resource system exchange of experience and technical knowledge learning
69. Livestock technology study and interchange
70. Development of high quality animal products and utilization of livestock by-product
71. Study of the promotion of management efficiency and local consumption for livestock industry
72. The study of training effectiveness and tracking assessment for young farmers in animal husbandry of Taiwan
73. Taiwan's young farmers livestock industry management capabilities and grading knowledge and ability counseling effectiveness analysis
74. Improvement of production efficiency by providing management service for poultry industry
75. Industry-oriented pilot study for agricultural technology project-operation of the management platform of livestock research institute
76. Research on technologies for propagation, farming management strategy and products processing in livestock development
77. Developing the management systems of wisdom monitoring dairy health
78. The development of superior quality livestock production information service system
79. Establish the system of circumstance monitoring for premium livestock production

Forage Crops

1. Selection of Napiergrass new lines
2. Breeding of Nilegrass (*Acroceras macrum*) elite lines
3. Fertilizer test of Napiergrass new lines
4. Improve of forage and feed production and quality
5. Study of Napiergrass cultivation under stress
6. Evaluation of forage soybean varieties in intercropping
7. Research on short-term forage production in summer-mixed cropping of forage corn and sorghum
8. Study on the friendly management system forage grass on the Northern Taiwan
9. Improvement of production and processing techniques for quality hay
10. Development of technologies for haylage manipulation
11. Evaluation of hay feeding value and application of hay grading
12. The area model of forage cultivar and production
13. Improvement of hay production, processing and feeding value
14. The effect of biochar on forage production and carbon sequestration
15. Development of technology on energy conservation and carbon reduction in the livestock industry
16. Study on enriching the carbon stock of perennial pasture by forage management
17. Collection and preservation of forage germplasm-collection and evaluation of lemgue forage in Taiwan
18. Introduction and exchange of legume forage germplasm from Republic of South Africa

Technical Service

Published papers

Journal of Taiwan Livestock Research VOL. 47 No.1 March 2014

Survey on the prevalence of caprine arthritis encephalitis virus in Taiwan: Feeding newborn kids with cattle substitute colostrum instead of their maternal colostrum

Shen-Shyuan Yang, An-Kuo Su, Sheng-Der Wang, Jan-Chi Huang, De-Chi Wang, Yi-Ping Lu and Kun-Wei Chan

Effect of forest grazing on cattle growth and plantation species

Kuen-Jaw Chen, Cheng-Yung Lin, Shi-Chuan Chang, Tzu-Rung Li, Jiunn-Cheng Lin, Tien-Szu Liao, Pin Chang, Yung-Hsiu Chen, Chin-Shien Wu, Chao-Hsien Hsieh, Churng-Faung Li, Ling-Tsai Wu, Hsieh-Pin Chu and Chun-Ta Chang

The effect of selected inoculants on fermentation quality of whole crop rice silage

Shu-Min Wang, Tsui-Huang Yu and Chia-Sheng Chen

Monitoring the diversity of MC1R and agouti gene in goats

Pi-Hua Chuang, Chia-Hsuan Chen, Chun-Ta Chang and An-Kuo Su

Evaluation the effect of biofilter media on reducing ammonia and odor emissions from a pig house

Ting-Hsun Hsiao, Yu-I Huang, Shao-I Sheen and Mei-Ping Cheng

Effect of temperature and digester types on methane production from dairy cattle wastewater

Min-Chien Cheng, Meeng-Ter Koh, Ting-Hsun Hsiao, Tzong-Faa Shiao and Mei-Ping Cheng

Comparison of barrows and gilts on the carcass cutability ratio, meat compositions and qualities for Duroc crossbred KHAPS black pigs

Hsien-Jung Huang, Chin-Bin Hsu, Hsiu-Lan Lee, Han-Sheng Wang, Churng-Faung Lee, Yan-Der Hsuuw and Cheng-Yung Lin

Comparison of barrows and gilts on the growth performance, carcass traits, muscle postmortem changes and hematological traits in finisher Duroc x KHAPS black pigs

Hsien-Jung Huang, Huey-Jiun Ko, Han-Sheng Wang, Hsiu-Lan Lee, Chin-Bin Hsu, Yan-Der Hsuuw and Cheng-Yung Lin

Journal of Taiwan Livestock Research VOL. 47 No.2 June 2014

The association study of microsatellite markers on swine chromosome 6 and the litter performance of parous sows

Ren-Bao Liaw, Yu-Chia Huang, Yong-Yu Lai, Ming-Che Wu and Hsiu-Lan Chang

Comparison of the milking ability of does and the growth performances of kids before weaning for Hengchun black goats and Boer goats

Shen-Shyuan Yang, Sheng-Der Wang, An-Kuo Su and Jan-Chi Huang

Establishment of a production facility and minimal disease White Roman geese group

Min-Jung Lin, Shen-Chang Chang, Yu-Shine Jea, Chun-Hsien Tseng, Jiunn-Wang Liao, Poa-Chun Chang and Chiou-Lin Chen

Body type score and organ weight during laying period of White Roman breeder geese

Min-Jung Lin, Tzu-Tai Lee, Yu-Shine Jea, Yang-Kwang Fan and Shen-Chang Chang

The establishment of online HACCP specification system of layer farm

Bin-Yeong Wang and Shii-Wen Roan

The effects of glutamine and glutamate supplementation on the growth performance of weaning pigs with lower weight gain

Chin-Bin Hsu, Hsien-Juang Huang, Hsiu-Lan Lee, Han-Sheng Wang, Fang-Chueh Liu and Chih-Hua Wang

Journal of Taiwan Livestock Research VOL. 47 No.3 September 2014

Study on diversity of agronomic traits of purple napiergrass in Taiwan

Huang-Cheng Chen, Jeng-Bin Lin, Tzu-Rung Li and Chin-Jin Hou

Establishment of wireless sensor network based system to improve the dairy farm management

Szu-Han Wang, Kuo-Hua Lee, Chun-Chieh Chiang, Fang-Chun Hsiao, Wan-Jung Chang and Chu-Li Chang

Effects of different extenders and removal of seminal plasma on goat semen quality during storage at 4°C

Sheng-Yang Wu, Perng-Chih Shen and Chia-Chieh Chang

Effects of lactation period and parity on raw milk composition in Holstein dairy cows

Chun-Ta Chang, Tzong-Faa Shiao, Churng-Faung Lee, Der-Wei Yang, Hsiu-Wen Ho and Chao-Hsien Hsieh

Effect of replacing dietary corn with pulverized rice on the growth performance and carcass traits in mule ducks

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

Position	Name	Subject	Country	Date
Associate researcher	Tien-Chun Wan	International DLG quality test for ham and sausage in 2014 as a guest tester	Germany	Feb. 8-13, 2014
Researcher and director	Jan-Chi Huang	With the implementation of the international cooperation and development fund in Papua New Guinea for the training program of development of semi-commercial agricultural and animal husbandry	Papua New Guinea	Feb. 20-Mar. 1, 2014
Researcher and director	Jan-Chi Huang	With the implementation of the international cooperation and development fund in Belize for the project of "Genetic Improvement in Sheep and Goat"	Belize	Mar. 25-Apr. 5, 2014
Director	Ing-Haur Huang	The 39 th International Committee for Animal Recording (ICAR) session, Berlin	Germany	May 17-24, 2014
Researcher and chief	Ming-Che Wu	The 39 th International Committee for Animal Recording (ICAR) session, Berlin	Germany	May 17-24, 2014
Assistant researcher	Chun-Hsuan Chao	The 39 th International Committee for Animal Recording (ICAR) session, Berlin	Germany	May 17-24, 2014
Director	Ing-Haur Huang	Double T dairy industry-Thailand & Taiwan	Thailand	May 25-29, 2014
Researcher and chief	Ming-Che Wu	Double T dairy industry-Thailand & Taiwan	Thailand	May 25-29, 2014
Assistant researcher	Chun-Hsuan Chao	Double T dairy industry-Thailand & Taiwan	Thailand	May 25-29, 2014
Researcher and chief	Wen-Shyan Chen	Double T dairy industry-Taiwan and Thailand-new movement of dairy products and global trade in Asian region	Thailand	May 25-29, 2014

Position	Name	Subject	Country	Date
Associate researcher and chief	Sue-Jan Lee	Double T dairy industry-Taiwan and Thailand-new movement of dairy products and global trade in Asian region	Thailand	May 25-29, 2014
Assisitant researcher	Hsiu-Lien Lin	Double T dairy industry-Taiwan and Thailand-new movement of dairy products and global trade in Asian region	Thailand	May 25-29, 2014
Researcher	Yih-fwu Lin	Study on animal welfare and organic rearing model in Denmark	Denmark	May 25-Jun. 7, 2014
Researcher and director	Jan-Chi Huang	The study on prevention and correction of selfsuckling behavior and production system in dairy goat	Netherlands	May 31-Jun. 13, 2014
Researcher	Tzong-Faa Shiao	Increasing dairy food consumption for children under three years old in Mongolia-the agricultural cooperation plan between Taiwan and Mongolia	Mongolia	Sep. 7-18, 2014
Assistant researcher	Meng-Ru Lee	The technologies in fermentation of new type animal products and in bacteria purification	Japan	Oct. 10-17, 2014
Assistant researcher	Hsin-Jung Lee	The technologies in fermentation of new type animal products and in bacteria purification	Japan	Oct. 10-17, 2014
Researcher and director	Jeng-Fang Huang	Attending the 10 th Asia pacific poultry conference	Korea	Oct. 17-24, 2014
Researcher and chief	Churng-Faung Lee	The first meeting of the joint working committee for cooperation in agriculture, forestry and fisheries between South Africa and Taiwan	South Africa	Oct. 19-27, 2014
Assistant researcher	Yu-Chun Lin	Risk analysis and management in food safety of animal product	USA	Oct. 26-Nov. 30, 2014
Assistant researcher	Yi-Ying Chang	The 17 th AAAP (Asian Australasian Animal Production) animal science congress	Indonesia	Nov. 7-16, 2014
Assistant researcher	Tsai-Tsu Chen	The 17 th AAAP (Asian Australasian Animal Production) animal science congress	Indonesia	Nov. 7-16, 2014
Assistant researcher	Ruei-Han Yeh	The 17 th AAAP (Asian Australasian Animal Production) animal science congress	Indonesia	Nov. 7-16, 2014

Position	Name	Subject	Country	Date
Assistant Researcher	Min-Chien Cheng	The 17 th AAAP (Asian Australasian Animal Production) animal science congress	Indonesia	Nov. 7-16, 2014
Assistant researcher	Chin-Hui Su	The 17 th AAAP (Asian Australasian Animal Production) animal science congress	Indonesia	Nov. 7-16, 2014
Researcher	Shiu-Yin Leu	The 17 th AAAP (Asian Australasian Animal Production) animal science congress	Indonesia	Nov. 7-16, 2014
Researcher and deputy director	Yu-Shin Cheng	Breeding stocks from Taiwan for animal industry in Southeast Asian countries with cooperation program	Phillipines	Nov. 20-26, 2014
Researcher and chief	Ming-Che Wu	Breeding stocks from Taiwan for animal industry in Southeast Asian countries with cooperation program	Phillipines	Nov. 20-26, 2014
Researcher	Neim-Tsu Yen	Breeding stocks from Taiwan for animal industry in Southeast Asian countries with cooperation program	Phillipines	Nov. 20-26, 2014
Assistant researcher	Hsiu-Lien Lin	Breeding stocks from Taiwan for animal industry in Southeast Asian countries with cooperation program	Phillipines	Nov. 20-26, 2014
Researcher and director	Jan-Chi Huang	At the invitation of Taiwan Chia-Nan goat milk farmers' cooperative as leader of the delegation of the European dairy goat industry	France, Netherlands	Nov. 23- Dec. 5, 2014
Associate researcher and chief	De-Chi Wang	Attending "the 41 th international embryo technology society" and publishing a paper	France	Jan. 9-14, 2015
Associate researcher	Tien-Chun Wan	International DLG quality test for ham and sausage in 2015 as a guest tester	Germany	Feb. 28- Mar. 5, 2015
Researcher and chief secretary	Chih-Hua Wang	The international committee for animal recording (ICAR) general assembly 2015 technical workshop	Poland	Jun. 8-13, 2015
Researcher and chief	Ming-Che Wu	The international committee for animal recording (ICAR) general assembly 2015 technical workshop	Poland	Jun. 8-13, 2015
Researcher and chief	Ming-Che Wu	International training course on dairy herd improvement by the use of biotechnology	Philippines	Jul. 13-22, 2015

Position	Name	Subject	Country	Date
Assistant researcher	Feng-Hsiang Chu	International training course on dairy herd improvement by the use of biotechnology	Philippines	Jul. 13-22, 2015
Assistant researcher	Szu-Hsn Wang	The study on animal welfare of dairy cattle in the Netherlands	Netherlands	Aug. 17-30, 2015
Assistant researcher	Hsiu-Lien Lin	Apply novel technology of sperm conservation to poultry industry	Japan	Aug. 23-Sep. 21, 2015
Assistant researcher and chairperson	Shen-Chang Chang	Development of floor-rearing breeding model and raising technology in breeding geese	Hungary	Aug. 26-Sep. 15, 2015
Assistant researcher	Chun-Hsuan Chao	Applying genomic selection to accelerate dairy cattle herd improvement	USA	Sep. 4, 2015-Jan. 29, 2016
Researcher and chief	Mei-Ping Cheng	Multi-discipline management of technology program	UK	Sep. 5-20, 2015
Researcher and director	Jeng-Fang Huang	Attending the foreign course of management development training course (MDT) for the senior civil service of Taiwan	Belgium	Sep. 5-18, 2015
Researcher and director	Jeng-Fang Huang	Attending the international waterfowl conference and publishing a paper	Germany	Sep. 21-25, 2015
Researcher and chief	Wen-Shyan Chen	Seminar on strengthening public-private partnership to reduce supply chain of fishery and livestock-reduce duck egg losses in the supply chain in Chinese Taipei	Philippines	Sep. 26-28, 2015
Associate researcher and chief	Sue-Jan Lee	Study of milk exam technology and proficiency test from ICAR reference laboratory network plan	Denmark	Sep. 26-Oct. 7, 2015
Researcher and chief	Ming-Che Wu	2015 APEC High Level Policy Dialogue on Agricultural Biotechnology (HLPDAB) meeting	Philippines	Sep. 29-Oct. 2, 2015
Associated researcher and chairperson	Hsiu-Chou Liu	Visit mainland China as the 39 th national top 10 outstanding agriculture experts for invitation from Taiwan agriculture exchange association	P. R. C.	Nov. 7-11, 2015
Researcher and director	Jan-Chi Huang	Attending the forth Qatar international agricultural exhibition 2015	Qatar	Nov. 7-14, 2015

Position	Name	Subject	Country	Date
Associate researcher	Shyh-Rong Chang	Study of the sustainable production technique of forage crops	USA	Nov. 8-21, 2015
Researcher and director	Jeng-Fang Huang	Attending the 5 th national seminar on local poultry development and publishing a paper	Indonesia	Nov. 16-22, 2015
Researcher and chief	Ming-Che Wu	Breeding stocks from Taiwan for animal industry in Southeast Asian countries with cooperation program	Vietnam	Nov. 24-30, 2015
Researcher	Neim-Tsu Yen	Breeding stocks from Taiwan for animal industry in Southeast Asian countries with cooperation program	Vietnam	Nov. 24-30, 2015
Assistant researcher	Ting-Yung Kuo	Breeding stocks from Taiwan for animal industry in Southeast Asian countries with cooperation program	Vietnam	Nov. 24-30, 2015
Assistant researcher	Hsiao-Yun Kuo	International cooperation on avian germplasm technology and translational application	Japan	Dec. 5-18, 2015

Training Classes

Program	Number of trainee	Duration
2014		
Management of chicken (advanced training)	15	3 days
Introduction of livestock	60	3 days
Artificial insemination of deer	20	3 days
Processing of livestock products	21	5 days
Identification of forage species	34	3 days
AI of goat	20	3 days
Utilization and management of forage	20	3 days
AI of dairy cattle	29	10 days
Management of chicken (Elementary training)	30	15 days
2015		
AI of pig	17	3 days
Introduction of livestock	100	3 days
Feed analysis	29	3 days
Identification of forage species	42	3 days
AI of deer	11	3 days
Processing of poultry and marketing strategy	21	3 days
Management of pig (advanced training)	18	10 days
Professional manager training of dairy cattle	30	15 days

Seminars and symposia

Speaker	Topic	Date
Double T dairy industry-Thailand & Taiwan		
J. Nutdechanan T. Pak-Uthai	Thailand Dairy Industry: Technology & Economics <ul style="list-style-type: none"> ● Technology ● Village economics 	2014.01.22
W. S. Chen J. T. Hsu S. J. Lee	Taiwan Dairy Industry: Extension & Trade <ul style="list-style-type: none"> ● Products & trade ● Health care of mammary gland ● Fatty acid, casein & ketosis screening 	
P. Chong	Tactics of livestock industry in Taiwan	2014.01.23
First season academic seminar		
M. P. Cheng	Report of agriculture climate change adaptation workshop of APEC	2014.02.18
L. H. Huang	Empowering technology of regenerative medicine	
Y. C. Liu	Agricultural innovation and marketing management	
J. H. Kao	Studies on rapid bioassay of pesticide residues	
Ketosis prevention of milking cow in proactive technology		
W. S. Chen	Products & trade	2014.02.24
S. J. Lee	Fatty acid, casein & ketosis screening	
J. Nutdechanan	Thailand dairy industry: technology & economics	
T. Pak-Uthai	Village economics	
Goat industry in Taiwan and Philippines		
Z. C. Huang	Research and development of goat industry in Taiwan	2014.03.04
P. A. Tu	Conservation and use of Taiwan black goat	
J. N. Nayga	Development in cagayan valley	
A. M. P. Alo	Recent advances in food preservation by hurdle technology	
First seminar of duck technology		
H. C. Liu	Development of sex identification of poultry	2014.03.21
C. H. Su	LED in poultry production	
J. H. Lin	Effect of by-products of agriculture on mule ducks, goose and broiler	
Empowering technology for pig breeding-Philippines & Taiwan		
S. S. Baguio A. M. Monleon	Philippine pig breeding technology: needs & RDE <ul style="list-style-type: none"> ● Technology R&D ● Pig breeds ● Genomic selection in pigs 	2014.03.27

Speaker	Topic	Date
M. G. N. Yebron, Jr T. C. Fernando J. G. Manalaysay M. A. Miguel L. M. Labonite	1. Biotechnology laboratory 2. Prolific gene 3. Stress gene 4. Sperm defect gene 5. Microsatellite markers	
C. B. Hsu Z. B. Zhu Y. Y. Song J. N. Xiao T. Y. Guo	Taiwan pig breeding industry: quality & challenges <ul style="list-style-type: none"> ● Prolific pig breed K ● Laboratory pig breed A, O and U ● Vision of pedigree registration of pig breeds ● Semen supply of pathogen-free boars ● Boar sperm chromosome breakage screening 	
P. Mermillod	Recent improvements of <i>in vitro</i> production of goat embryos and research perspectives	2014.05.01
Ketosis prevention of milking cow in proactive technology		
S. J. Lee	Fatty acid, casein & ketosis screening	2014.05.01
S. D. Zhuang	Ketosis screening and application	2014.05.13
J. T. Xu	Fatty acid screening and application	2014.06.03
Y. G. Fan	Casein screening and application	2014.06.10
Second season academic seminar		
Y. C. Lai	A compared of the root yield and trypsin inhibitor activity of sweet potato lines for animal feeds	2014.05.20
Recent progress in swine breeding and raising technologies		
J. T. Napel	Using today's technology for breeding pigs for tomorrow's condition	2014.06.03- 2014.06.04
S. Mikawa	Development of marbling pork with marker-assisted selection	
E. C. Lin	SNP and protein markers for embryo development at early stage identified from functional genomics in Landrace	
M. C. Wu	Networking system for marker-assisted selection in pigs	
C. W. Liao	Lysine and metabolizable energy requirement for prolific lactating sow	
F. C. Liu	Production of recombinant pepsin, pancreatic lipase and colipase from <i>pichia pastoris</i> as feed additive	
I. H. Kim	Advanced dietary system without antibiotics in Korea's swine industry	
Y. L. Lin	Managing pig health by biosecurity practice	
J. Carr	Improvement of herd productivity by pig management through pig flow and batching	

Speaker	Topic	Date
S. H. Lee	Pathological diagnosis on major pig diseases in Taiwan	
M. Katsumata	Promotion of intramuscular fat accumulation in porcine muscle by nutritional regulation	
W. S. Chen	Promotion of intramuscular fat accumulation in porcine muscle by nutritional regulation	
T. Shioda	Traceability on pork in Japan	
W. Tantasuparuk	Pig production in Thailand	
N. M. Dung	Pig production and marketing in Vietnam	
M. S. A/L. G. Singh	Swine breeding and production in Malaysia	
A. J. Barroga	A dynamic Philippine swine industry: key to meeting challenges and technological innovations	
Ir. P. H. Siagian	Pig production in Indonesia	
Cutting-edge reproductive technologies and perspectives for their usage in swine		
H. Rodriguez-Martinez	Current status and perspectives of artificial insemination in pigs	2014.06.05
T. Okazaki	Cryopreservation of boar spermatozoa. The curious functions of seminal plasma during freezing or thawing	
Y. Hirao	<i>In vitro</i> growing of immature porcine oocytes	
C. G. Grupen	Current status of porcine embryo <i>in vitro</i> production	
T. Somfai	Cryopreservation of <i>in vitro</i> produced embryos and immature oocytes in pigs	
K. Yoshioka	Establishment of practical embryo transfer for fresh or frozen embryos in pigs	
S. Haraguchi	Establishment of ES (Embryonic stem) cell like cells in pigs	
L. R. Chen	Research and development of porcine embryonic stem cells in Taiwan	
K. Kikuchi	Setting up the international projects on porcine bio- and genetic diversity	
Certification system for genetic products in animal industry		
Dr. M. Depont	Cryo bio system (IMV)	2014.06.05- 2014.06.06
J. D. Deng F. H. Yang H. L. Lin	Chicken semen	
M. H. lin Z. Y. Zhou L. Y. Wei	Duck semen	

Speaker	Topic	Date
R. H. Zheng M. R. Lin	Goose semen	
H. Haresan	Sexed semen in Japan	
K. Tanaka	Breeding in Japan	
C. R. Liu D. R. Huang J. X. Zhao	Dairy cattle semen	
C. Y. Chen	Dairy cow frozen semen imported inquiry system	
M. C. Chen C. J. Wang	Dairy frozen semen imported	
Q. L. Zhuang K. X. Chen	Goat semen	
W. L. Houg	Goat frozen semen importe	
D. J. Wang	Goat frozen embryos and quarantine conditions of imports into USA	
K. F. Lin	Deer semen	
P. M. Chen X. H. Lin	Deer frozen semen	
J. N. Xiao M. Y. Wang J. H. Hong Q. L. Zhuang J. Yang	Pig semen	
Second seminar of duck technology		
L. Y. Wei	Duck semen cryopreservation	2014.07.29
Y. Y.Chang	Genetic research in ducks feather color	
Z. S. Zheng	Ozone is used in hatchery	
C. F.Huang	Effect of feeding conditions for ducks on growth performance, carcass traits and animal welfare	
Third season academic seminar		
D. Y. Lin	The metagenomics of microbiome in cecal contents of coccidian infected native chicken	2014.08.19
S. C. Jiang	Animal disease model of mice	
Z. T. Lee	Effect of feeding by-products of agriculture on antioxidant capacity of animals	
Seminar of goose technology		
M. R. Lin	Growth performance test and Beidou White Goose LRI-1	
C. C. Chang	Development and application of intelligent remote monitoring system in goose homes	

Speaker	Topic	Date
Seminar of goat propagation and production management		
C. C. Huang	Propagation and production management of goat	2014.09.26
S. X. Yang	Reuse by-products of agriculture on goat	
Seminar of goat breed and management of feeding		
V. H. Emiel J. B. Maria	Genetic improvement of goat in Netherlands	2014.10.10
V. H. Emiel J. B. Maria	Management of feeding of goat in Netherlands	
Fourth season academic seminar		
D. Z. Lu	Development of international goat industry	2014.11.04
C. H. Ke	Ability of remolting heavy metals and produce biomass alcohol in fast-growing grass	
W. J. Guo	Anaerobic (co)-digestion of organic wastes-past, present and the future	
J. G. Zhou	The egg processing characteristics and application	
The seminar in Hsinchu Branch		
J. L. Chang	Career review and experience sharing	2014.11.05
J. X. Zhao	Bull semen collection and frozen semen production	
K. H. Lee	E-management in dairy farm	
S. X. Liang	Black soldier fly study status and prospects	
Y. M. Shi	Review of forage research in Hsinchu branch	
Z. Y. Chen	Quality dairy cows breeding - Introduction TDC website	
S. J. Lee	Improved bacterial counts and somatic cell count of raw milk in Taiwan	
Second seminar of forage crops		
C. C. Huang	It is necessary to producing high-quality domestic hay	2014.11.13- 2014.11.14
M. L. Chang	Pangolagrass status in production, sales and feeding	
Q. X. Lu	Grass can make carbon reduction	
C. P. Lin	Management of rhizoma pangolagrass	
Y. M. Shi	Development and application of forage preservation technologies	
S. X. Liang	The potentiality of oats as a forage	
S. B. Xiao	Nilegrass production current situation and prospects	
C. F. Lee	Evaluation pangolagrass nutritional value and grade	

Speaker	Topic	Date
X. H. Liu	Use energy saving way to drying forage	
X. H. Liu	Haylage improvement and microbial development	
S. M. Wang	Development and application of biochar	
J. S. Chen	Herbivore's foods in Taiwan	
Seminar of pig embryo reproductive technology		
T. Nagai	Development of pig embryo reproductive technology	2014.12.19
T. Nagai	Application of pig embryo reproductive technology	
First season academic seminar		
S. C. Jiang	Genetic engineered murine model services	2015.02.10
W. Z. Chang	Animal ethic guidelines for research	
J. W. Liao	Toxicological evaluation for genetically modified plants derived food and case study	
Seminar on dairy balue chain integration and innovation & prolific ten tons cow award		
G. Y. Guo	Status of dairy products quality control	2015.03.17
Y. J. Lin	Introduction of featured dairy products	
N. Cai	Introduction of domestic cheeses	
S. J. Lee	Fatty acid, casein & ketosis screening	
Z. Q. Shi	Analyze and manage data of dairy cows	
J. X. Zhao	Taiwan join ICAR reference laboratory network	
Conference for pig genetic networking-Philippines & Taiwan		
S. S. Baguio	Pig breeding stock evaluation and supply	2015.04.22
J. R. V. Herrera	Gene Screening of imported Breeds	
R. B. Liao	Stress gene and prolific gene	
J. X. Chen	Black pigs marketing	
M. C. Wu	Teat counts 88 line breeding	
First seminar of forage crops		
Z. R. Lee	Napiergrass varieties characterization	2015.04.29
C. F. Lee	TMR adjustment strategy in summer	
Y. M. Shi	Study of tissue culture on digitgrass var. 'Survenola'	
M. Z. Lu	Forage crops utilization and modulation in Penghu	
M. L. Chang	Mixed cropping of forage corn and sorghum	
M. H. Zhu	Comparison of intercropping-systems of perennial legumes with forage corn	
A. B. Riber	Broilers and laying hens welfare-heating lamps, nest box and LED	2015.05.05

Speaker	Topic	Date
A. B. Riber	Poultry organic production in Danish	
Second season academic seminar		
S. B. Xiao	Review of forage breed	2015.05.15
M. X. Zhou	Biogas desulfurization and characteristics of gases vented from maize straw compositing	
Y. K. Lin	Optimization methods on animal by-products utilization and biomaterials design	
Certification system for genetic products in animal industry		
A. Sarabia	Buffalo semen for global marketing	2015.06.04- 2016.06.06
T. Nagai	Cattle embryo frontiers	
L. Chevrier	Analysis of sperm motility, concentration and morphology	
H. Haresan	Effectively utilize reproduction technology on farm management	
K. Tanaka	Future direction of Japanese bull breed	
C. R. Liu J. X. Zhao	Dairy cattle freezing embryo	
Z. K. Xu	Dairy cattle freezing semen	
R. C. Chen Y. F. Wei	Goat semen & freezing embryo	
C. Y. Lee	Evaporative cooling in goat stables	
D. J. Wang	Goat freezing semen	
K. F. Lin	Deer semen	
Z. C. Wen	Effect of Taiwan and New Zealand trade agreement on deer industry	
X. H. Lin	Deer frozen semen supply and promotion	
H. L. Lin	Chicken semen and fertilized egg	
L. C. Chen	Development of hatching and disinfection equipment	
L. Y. Wei	Duck semen and fertilized egg	
J. H. Chen	Development of waterfowl hatching equipment	
M. R. Lin	Goose semen and fertilized egg	
C. H. Lin	The situation of Taiwan goose industry after avian influenza	
J. N. Xiao	Pig semen	
J. H. Shi	Pig frozen semen of SGI	
M. X. Wu	Animal drugs quality change from the GMP to cGMP	
M. X. Wu	Animal health after post-antibiotic era	
Z. J. Xiao	Automatic detection of sow estrus	

Speaker	Topic	Date
J. N. Xiao	Safety of artificial insemination tool	
C. C. Jiang	Introduction of the instruments of semen testing	
J. D. Lin	Quality of swine and choose	
Third season academic seminar		
S. X. Yang	Gene transfer technology for human gene therapy	2015.08.11
Y. T. Zhu	The current development and future perspectives of genetic study of miniature pigs in Taiwan	
J. D. Liao	Review and expectation on food safety incidents in recent years/introduction of important TFDA's official methods	
The seminar in Hsinchu Branch		
K. H. Lee	Cattle health management	2015.09.23
S. J. Lee	The advantage of joining DHI	
S. H. Wang	Experience sharing of visiting Dutch	
M. P. Cheng	Effect of amending the law of water pollution on dairy farming	
Y. H. Wu	How to prevent bovine ephemeral fever	
T. A. Garran	Ecological agriculture and forage crops in sustainable development	2015.10.08
W. H. Chen	How to release your stress	2015.10.13
Robotic milking herds for cow productivity		
Y. C. Jia	Services of DHI	2015.10.15
W. L. Hung	Rotary milking	
S. Kold-Christensen	Global experience on ketosis screening by FTIR technology	
S. Kold-Christensen	A revolutionary new tool for mastitis screening	
S. Kold-Christensen	Recent advances in FTIR	
M. C. Wu	Robotic milking system for Taiwan	
Second seminar of forage crops		
S. H. Wang	Study of feeding carrot pomace silage on dairy cow	2015.10.27
S. X. Liang	Assess traits of different sorghum	
Z. B. Lin	Selection and naming pennisetum 7768	
Q. X. Lu	Effect of nitrogen on nitrate nitrogen content of pennisetum	
S. M. Wang	Effect of fermentation on inoculation and withering of pangu grass/alfalfa mix grass silage	
J. S. Chen	Discussion on drying efficiency improvements of forage	
J. S. Chen	Forage cultivation program	

Speaker	Topic	Date
Seminar of livestock embryo application		
T. Nagai	Development and application of research about <i>in vitro</i> embryo production in livestock	2015.11.02
D. J. Wang	Effect of sonic hedge hog protein on <i>in vitro</i> early embryo	
Fourth season academic seminar		
C. X. Hsien	Grass physiological responses in different circumstances	2015.11.10
M. P. Cheng	Study reports about joining the training of Executive Yuan cross-cutting technology and management talent	
S. L. Kuo	Food safety and inspection of animal products	
Seminar on increase survival rate of lamb		
D. J. Wang	Effect of artificial feeding mode in immunized and control specific disease on lamb	2015.12.04
K. L. Chen	Assess the feasibility of feeding probiotics on weaning lamb	
J. T. Hsu	Management strategies of increase survival rate of lamb	
K. W. Zhan	Diagnosis and treatment of common diseases in lamb	
Performance test services for pork production-Philippines & Taiwan		
R. Micalat-Sonaco	Philippine national livestock program of the department of agriculture	2015.12.11
M. Z. Hong	ASEAN+Taiwan pig industry vision	
A. G. Eguia	Sustainable technology for the adoption of the beneficiaries of the livestock extension services (STABLES)-The ATI agenda	
C. E. Balancio	Philippine regional extension program-the case of region 7	
P. H. Hsiao	Increasing uniformity of finished pigs by empowered purebred	
Forum for pork consumption patterns-Philippines & Taiwan		
C. H. Huang	Consumption favor patterns in processed pork market	2015.12.12
R. Micalat-Sonaco	Consumption patterns in Philippines	
M. C. Wu	Needs on Omega-3 Pork	



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