# Foreword

The year 2011 marks the centenary of Republic of China which was established in 1911. The rapid development of livestock industry of Taiwan in the last century has made a great change from small scale side-line farm family business into large scale enterprise. During the past decades, Livestock Research Institute has contributed significantly to this development. Results in the fields of breeding and genetics, physiological biotechnology, feed nutrition, forage crops, processing and utilization, management and use of waste resource in the year 2010-2011 have been accomplished through the execution of 296 research projects and 13 academic-industry projects, 455 published research paper, 5 new selected breeds, 5 earned patents, 33 technical licensing and 14 recruited incubatee. Furthermore, we have held two important international training workshop and symposium on assisted reproductive technologies for livestock genetic improvement and international symposium on genetics and reproductive management for animal production in 2010 and 2011, respectively. Training workshop and symposium such as these two are important in highlighting ways in which we can work together locally and internationally on genetics and reproductive management for animal production. As is known to all, there are excellent breeding stock industries along with elite farm animals in Taiwan. We also hope that Taiwan can be acted as a breeding stock providing center for livestock farming in Asian-Pacific countries. Finally, we are certain that these efforts will further the availability of research and development resources. We would like to see more active interaction among the industry, government and academies in the years to come. We have taken pains in compiling materials for this booklet so they could be used for search, application and reference. We would highly appreciate your comments and suggestions.

Ing-Haur Huang, Ph. D.
Director
Livestock Research Institute
Council of Agriculture

# Contents

# Research and Development

## Animal Breeding and Genetics

### Reproductive genotype influence on performance of milk yield and quality in cow

Selection of heat-tolerance milking cow in Taiwan is based upon the database of DHI. Cow milk DNA was used to identify the genotype of four reproductive genes such as BLAD, CITL, CVM and DUMPS. There were 19,759 head of milking cows tested on the period of April to September of 2010. A total of 4,881 head having month milk sampling of six and with a mean of 305-2X-ME milk yield greater than 7,500Kg but only 933 head having genotypes of reproductive gene of BLAD, CITL, CVM and DUMPS. All of 933 cows had favorable genotype of CITL-TC and DUMPS-TD. Cows with BLAD and CVM genotypes were classified into four groups as follows: BL-CV (n=2), BL-TV (n=22), TL-CV (n=91) and TL-TV (n=818). Four groups of BLAD-CVM genotypes had mean breeding value of 305-2X-ME milk yield with +469, +594, +502 and +568 Kg, respectively; mean breeding value of milk fat with -2.8, +16.9, +12.1 and +17.9 Kg; mean percentage of fat content with 3.068, 3.695, 3.608 and 3.704%; mean percentage of protein content with 3.066, 3.267, 3.255 and 3.292%; mean cell count of somatic cells with 28.8, 37.6, 32.7 and 26.7 x10,000 cells/mL; the lowest number of somatic cell counts with 13.5, 5.8, 8.0 and 7.6 x10,000 cells/mL. Results indicated that cows having a favorable genotypes of TL-TV had production performance on higher milk yield and better milk quality during the hot period from April to September.

*(M. C. Wu, H. L. Lin, D. Y. Lin , C. L. Chang, S. J. Lee, J. Y. Chen, E. M. Shy, H. I. Huang, C. H. Bair, L. T. Chen, J. L. Ding and C. S. Wang)*

### Dairy cows having greater then 55 KG of daily milk yield associated to month of age and milk quality

Breeding scheme of dairy cattle, selection on milk yield and quality associated with reproductive performance is essential to the hot and humid weather, and therefore selected cows will become a heat-tolerance line in Taiwan. Data were used to study the top records on daily milk yield having greater than 55 kg and their age and milk quality from January of 2001 to October of 2011 based upon www.angrin.tlri.gov.tw. The highest record of 72.2 kg on daily milk yield was recorded and there were a total of 511 records having greater than 55 kg on daily milk yield, and with a mean of 57.9 + 3.0kg. A mean of milking age was 64.3 + 19.2 months old with ranging between 24 and 157 months of age. There was 45% (234/511) of those cows having highest daily milk yield within 60 months of age. For those of Top 511 cows in daily milk yield, their milk fat (F), protein (P), lactose, somatic cell counts, urea nitrogen, citric acid and P/F ratio were 3.17 + 0.81%, 2.89 + 0.25%, 4.79 + 0.26%, 17.7 + 39.6 x $10^3$/mL, 12.3 + 5.3 mg/dL, 187 + 27 mg/dL, and 0.96 + 0.26, respectively, as comparison to the average of 168,913 milk samples with 3.74% fat, 3.30% protein, 0.91 of P/F ratio, 4.77% lactose and 333 x 103/mL cell counts in 2010. It indicated that the top 511 cows had a significantly less fat%, protein%, and somatic cell counts. It indicated that high yield resulted in a less fat and protein percentage. In conclusion, selection on both milk yield and quality trait in those of cows having greater than 55 kg on daily milk yield would be feasible along with improvement on quality traits including of milk fat, protein, lactose and somatic cell counts under a breeding scheme for dairy cattle in Taiwan.

*(M. C. Wu, Y. Y. Lai, H. L. Lin, C. L. Chang, S. J. Lee, J. Y. Chen, E. M. Shy, I. H. Hwang, L. T. Chen, J. L. Ding, P. Y. Yue and C. S. Chen)*

## The pedigree of paternal sires for elite dairy cows in Taiwan

Taiwanese elite cows were a group of high-quality dairy cows adapted to hot and humid climate of Taiwan and bred from imported frozen semen. The information of tracing pedigree showed 19 sires and four common paternal ancestors for these cows in this study. In order to explore the genetic background of these elite cows, the data sets from Diary Herd Improve Program and Animal Genetic Resources Network in Taiwan (http://www.angrin.gov.tw) were joined and traced. With Pedigree Viewer package pedigree diagrams of 235 elite cows of 2010 were depicted, all elite cows had more than six lactation records, 305- 2X-ME milk yield higher than 9,000 kg, breeding value of 305-2X-ME milk yield higher than 700 kg, average somatic cell count lower than $30 \times 10^4$/mL and protein% higher than 3.2%. Nineteen sires and four common paternal ancestors, CAN000000249633, USA000001038509, USA0000001189870, and USA000001013415 were traced. Taiwan Holsteins propagated by purebreeding, the traced pedigree of Taiwanese elite cows can provide useful decision support information for the dairy farmers.

*(J. Y. Chen, K. H. Lee, C. L. Chang and Y. N. Jiang)*

## The genetic merits of the imported dairy frozen semen and their progeny performance in Taiwan

The average of imported dairy freeze semen from U.S.A., Canada, Japan and Netherlands was 78,880 dos per year in Taiwan. Among them, imported from U.S.A and Canada were 94%. The genetic merit of these bulls' semen would deeply effect on the production performance and breeding levels of Taiwan Holsteins. According to the data analysis of DHI and imported freeze semen database, the 200HO00044 was the most popular semen for breeding in recent 8 years. The estimated breeding value for milk yield and reliability of this bull were 1,562kg and 99%, respectively. The mean of 305-2X-ME milk yield of his daughter cows was 8,575 (n=229). The farmers were more likely to use it for breeding as less risks of for this bull. Comparison of the data showed the priority of first, third and fourth in DHI bulls were also the popular imported freeze semen for first, second and fourth. It means popular semen really much used for breeding DHI cows. Yet, there were much environment difference between Taiwan and Imported country, The rank of milk yield of genetic ability for bulls and 305-2X-ME performance of DHI daughter cows would be a little different. The genetic estimate information of the breeding bulls was very important to farmers. Online System for Inquiring Genetic Information of Elite Holstein Breeding Bull (SIGB) website would be established by Hsin-chu Branch, Livestock Research Institute. There would be much information of sire summary from USA and CAN offering for the farmer breeding decision.

*(J. Y. Chen, K. H. Lee, C. L. Chang and Y. N. Jiang)*

## Decision support system of selecting elite Holstein bulls for improving progeny performance

Hsin-Chu Branch, Livestock Research Institute, TLRIHC, delivers a new generation Decision Support System of Selecting Elite Holstein Bulls for Mating to Improve Progeny Performance, SBIP. The SBIP network system utilizes electronic dairy concepts from knowledge management and dairy farm operations to decision making. The system contains four modules: 1. The inquiring module for genetic performance of bull, provides genetic information of international (USA, Canada, Netherlands and Japan) elite bulls by established database, which can offer semen inventory for farmers. 2. The inquiring module for imported semen is based on the historical data of imported semen maintained by TLRIHC. The online system can provide information for choosing available semen to breed cows. 3. The extended information management system module of DHI is to enrich digital management reports of DHI system on cloud to enhance efficiency of dairy industry e-service (under construction). 4. The dairy specialized knowledge database module, contains e-book of Dairy Farmer News, dairy dictionary and e-publishes, a variety of special informational publications. The SBIP system can help farmers to master varied genetic information of productive traits of bulls (frozen semen) and digital reports of DHI's cow, let

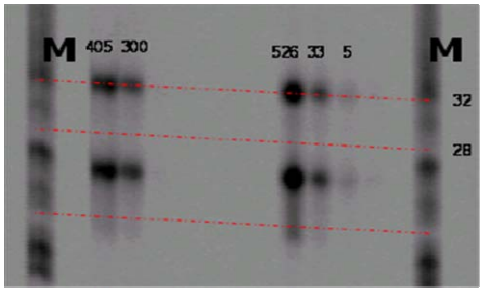
farmers have more confidence to plan breeding strategies to achieve the goal of breeding elite cows with high productivity, good body conformation and increased longevity.
*(J. Y. Chen, K. H. Lee, C. L. Chang and Y. N. Jiang)*

## Study on the model of breeding dairy farms operation and breeding cattle supplying system

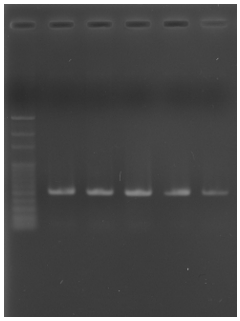
The data analysis of 15 breeding dairy farms operation fron 2010 through 2011 showed that the average of milk quality records of DHI was 2.3, 436 days of calving interval, 23kg of daily milk yield, 3.76% of fat%, 3.28% of protein %, 4.82% of lactose %, and 8700kg of 305-2X - ME milk yield. The calving rate in month was 33.9% from January to March. In addition, the shortest calving interval is 420 days for February calving cows. However, most calving interval is under 13 months. There were 3,299 cows which the milk yield were over 10,000 kg were from breeding dairy farms. They occupied 26% of DHI Ten Ton cows. The average of 305-2X - ME milk yield for them was 10,776 Kg. 401 cows were type classified and the final score averaged was 82.9. There were 5.0%; 4.5%; 3.2% and 3.2% of cows need to be corrected on their rear legs, udder depth and rump angle by mating with specific bull semen. The result showed that the type of elite cows were better than others 4,030 cows from the breeding dairy farm were on pedigree registry. The results this year will serve as a basis for comparison with those of the next 4 years to review and to improve for establishing the standard operation model.
*(C. C. Chiang, C. L. Chang, S. H. Wang, F. C. Hsiao, K. H. Lee, J. Y. Chen and W. J. Chang)*

## Monitoring of Genetic Diversity for Water Buffalo and Black Goat in Taiwan

The purpose of this study was to analysis the difference of mtDNA for Taiwan water buffalo and black goat, BLAD, MC1R and Agouti gene. The D-loop 920bp in length of Taiwan water buffalo was determined. There are 7-8 Poly G and 10 Poly C at 140 bp and 750 bp of D-loop. Comparison of these sequences revealed 9 polymorphic sites which accounted for 0.97% of the D-loop sequence. Three transitions and six transversions were determined. The BLAD gene in Taiwan water buffalo was studied and the result was normal type. The phylogenetic trees of mtDNA 12SrRNA, 16SrRNA, ND1~5 genes of Taiwan black goats were placed into two lineages. There were only 2-3 haplotypes of each different gene region. The results showed that the sequences of the three genes were conservative. The evaluation of the diversity of MC1R and Agouti gene among the Taiwan native black goat, Nubian goat and crossbred of Nubian and Taiwan Native goats were determined. The result found that the gene of MC1R had a 856bp sequence. Meanwhile, there were five single nucleotide polymorphism (SNP) identified in this experiment, which were located at 183, 676, 701, and 801 bp in MC1R gene respectively. In addition, the gene of Agouti intron 1 had a 476 bp sequence. However, there was only T128 insertion found in Nubian goat. Agouti exon 4 sequenced had a 603bp on part of intron 3 and exon 4 region of Agouti gene. The transition pairs of 132C/A and 134A/G were recognized only in Nubian goat.
*(P. H. Chuang, H. Y. Kuo and A. K. Su)*




Photograph of BLAD PCR product in Taiwan water buffaloes



Photographs of ethidium bromide strained gels of Agouti PCR products

## Maintenance and Management of Genetic Resources in Taiwan Yellow Cattle and Black Goat (2010)

The present conservation population of Taiwan Yellow Cattle and Black Goat at Hengchun Branch, LRI are 302 and 71, respectively. The effective population number for yellow cattle and black goat are 23.3and 18.1, respectively. Forty-two yellow cattle (25 males, 17 females) were extended to 8 farms which 4of them were newly established raising units. Due to goat disease monitoring and controlling, the black goat were extended only 5 heads (1 male and 4 female) to Penghu Center, LRI. With respect to the Yellow Cattle tracing and investigation, 13 farms were visited, and 6 of them have abandoned Yellow Cattle raising, while the other 7 farms still remained pure-breeding, which of 4 farms have steady increased raising numbers than their initial introduction period. As for genetic diversity analysis, conserved yellow cattle population in Hengchun Branch, LRI and yellow cattle in Kinmen area had very similar result in the microsatellite markers analysis with high Polymorphism Information Content (PIC) of 0.68 and 0.67, respectively. The mtRNA DLoop analysis showed that black goats in Hengchun Branch, LRI have 3 haplotypes, while 8 haplotypes were seen in the black goats at Hualien Propagation Station. Two populations of black goats in different areas have close genetic relationships. Besides, if compared to the Mainland China coastal black goat, genetic relationships were found among these three groups of black goat owning to have the same one haplotype.

*(G. F. Li and S. S. Yang)*

## Maintenance and Management of Genetic Resources in Taiwan Yellow Cattle and Black Goat (2011)

Fifty-seven yellow cattle were released to beef farmers this year and the total accumulative extended number were 187 in recent three years. As to the dispersing conservation of this conserved cattle, 5 farms were newly established this year and totally of 13 private units now joining the yellow cattle-raising since 2009. With respect to the field investigation of yellow cattle, 5 to 6 that out of 40 cattle in the Huxi rural area of Penghu county were identified as pure yellow cattle according to the typical appearance and body type of breed standard. Taiwan black goat was immigrated to Penghu station, LRI as the seed stock for future extension of resourse in Penghu area. Eight black goat (2 male and 6 females) were released this year and the accumulative extended number were 13 (3 male and 10 females). As for genetic diversity analysis, 11 genetic markers were used to conduct the microsatellite analysis and the primary result showed that: black goat in Kinmen area had medium Polymorphism Information Content (PIC) of 0.41 with average observed heterozygosity of 0.34 and average expected heterozygosity of 0.47, which revealed that the genetic diversity of black goats in Kinmen area were not sufficient and more attention need to be paid in the field of breed resources management for the local research unit and farmers.

*(G. F. Li and S. S. Yang)*

## Selection of goat breeds adapted to the local environment (2010)

The progress on selection of tropical line of Alpine has been retarded due to the disease control project conducted in Heng-Chun Branch, LRI. Detection of G6S gene defect in bucks, test of CAEV and registration of pedigree in Alpine herds were carried out continuously this year. The results on selection of Heng-Chun Black Goat with 87.5% of Boer showed that the birth rate, kidding rate, percentage of singlet and twin were 65.6, 167, 33.3, and 66.7%, respectively. The percentage of kids with solid black plus those with nearly black of coat color was up to 60%. The mean body weight at birth, 3, 6, and 9 month of age kids were 2.83 ± 0.73 kg, 18.86 ± 1.77 kg, 30.8 ± 4.3 kg and 42.2 ± 6.0 kg, respectively in male kids, and 2.47 ± 0.31 kg, 17.49 ± 2.24 kg, 26.3 ± 3.0 kg and 34.4 ± 4.6 kg, respectively in female kids. The average daily weight gain during the period of birth to weaning, 4th to 6th month, and 7th to 9th month of age were 0.187 ± 0.040 kg, 0.128 ± 0.027 kg and 0.109 ± 0.021 kg, respectively in male kids, and 0.163 ± 0.020 kg, 0.102 ± 0.020 kg and0.075 ± 0.017 kg, respectively in female kids.

*(S. S. Yang, S. D. Wang, A.K. Su, G. F. Li, D. C. Wang and J.C. Huang)*

## Selection of goat breeds adapted to the local environment (2011)

In addition to the monitoring of CAE and melioidosis in original dairy herd, twenty-five Alpine does were introduced to Heng-Chun Branch to expand the basic population of breeding herd. The average daily milk yield of original dairy herd within 30, 60 and 90 days postpartum were 2.84, 2.92 and 3.34 kg, respectively. Milking was then ceased thereafter due to the disease control. For the selection of Heng-Chun Black Goat, the kidding rate, incidence of twin births and percent of kids with solid black coat were 200% (16/8), 100% (8/8) and 37.5% (6/16), respectively. The cumulative data on growth performances of Heng-Chun Black Goat showed that the average body weights at birth, 3 and 12 months of age were 3.4 ± 0.6 kg, 17.7 ± 3.1 kg and 46.6 ± 11.4 kg, respectively in male kids, and 3.0 ± 0.6 kg, 15.4 ± 2.4 kg and 31.7 ± 6.8 kg, respectively in female kids. Growth rate of kids irrespective of gender tended to be higher during the stage before 9 month of age than that after 9 month of age.

*(S. S. Yang, G. F. Li, S. D. Wang, A. K. Su, D. C. Wang and J. C. Huang)*

## Goat breeding and improving program

The purpose of the breeding program was to breed the goats (Ji-An goat) with advantages of Nubian breed and Taiwan Native Goats. The result showed there was no significant difference on the birth weight of male kids among the F1~F5 generations. The best performance of body weight in female kid at birth was found in F5 generation. The body weights of kids at $3^{th}$ and $6^{th}$ months were highest in F5 generation. The average daily gain of male and female kids from birth to $3^{th}$ month, $4^{th}$ to $6^{th}$ months and $6^{th}$ to $12^{th}$ month of were 0.12 vs. 0.11kg, 0.09 vs. 0.06kg and 0.05 vs. 0.04 kg, respectively. According to the results of the regression calculated, the correlation between chest girths with body weight was the highest among another regression. The regression formula of male and female kids were Y = 0.6109 * X-17.277, R2 = 0.9418 and Y = 0.5499 * X-14.929, R2 = 0.949 (Y = body weight and X = chest girth) respectively. Evidence showed that the F1 female Ji-An does had a highest 210% of kidding rate among generations. Meanwhile, the percentage of solid black fur among generations was also highest in F5 generation.

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

## Genetic diversity of black goats evaluating by microsatellite markers

The aim of this study was to investigate the genetic diversity of black goats using microsatellite genotyping. A total of nine microsatellite markers were used to genotype 60 black goats of Hualien propagation station, Livestock Research Institute. The allele number for all loci ranged between 2 to 9, and the mean allele number was 6.22 ± 2.11. The mean values for observed heterozygosityg (Ho), expected heterozygosity (He), and polymorphism information content (PIC) were 0.53 ± 0.02, 0.59 ± 0.06 and 0.55 ± 0.18, respectively. From the analysis of ETH10 marker, there were only two genotypes with 198/198（10%）and 208/208（90%）in the goat population. Therefore, Ho of this goat population was zero. The values of Ho and He deduced from other loci were almost no less than 0.5. PIC values obtained from the analyses of microsatellite markers except for ETH10 and ILSTS005 were larger than 0.5, and the mean values of all markers were also larger than 0.5, indicating that the genetic diversity of this goat population was high.

*(R. B. Liaw, R. J. Chern, H. L. Lin, P. H. Chuang, J. Y. Lin, M. P. Cheng and M. C. Wu )*

## Analysis of mitochondrial DNA D-loop region in Hengchun black goats

The purpose of this study was to investigate the phylogenetic relationships among Hengchun black goats and other goats using mitochondrial DNA (mtDNA) D-loop sequences. Total DNA was extracted from blood samples of Hengchun black goat, solid black Boer goat, Taiwan black goat, Boer goat, and Nubian goat. The primer pair specific to mtDNA D-loop region of goat was designed and used to

amplify 21 goat DNAs. After purification, the PCR products were sequenced by an automatic DNA sequencer. We also downloaded mtDNA D-loop sequences of Yudong white goat, Nanjiang goat, Qianbei grey goat, Guizhou white goat, Lezhi black goat, Yingshan black goat, China Boer goat and Ammotragus Lervia goat (out group) from NCBI GenBank. All the sequences of D-loop region were used to construct phylogenetic trees using Neighbor-joining methods. The results showed that all analyzed goats were divided into five groups using phylogenetic relationship analysis, of which Hengchun black goat, Taiwan black goat, solid black Boer goat and Nubian goat was in the first group; Yudong white goat was in the second group; Guizhou white goat was in the third group; Nanjiang and Qianbei grey goats were in the fourth group; Lezhi black goat, Yingshan black goat, China Boer goat, and Boer goat was in the fifth group. Based on the above results, Hengchun black goat has a phylogenetic indication closely relating to Taiwan black goat, Nubian goat and solid black Boer goat.

*(C. H. Chen, S. D. Wang, M. T. Chang, P. H. Chuang, S. S. Yang, G. F. Lee, M. C. Wu and J. C. Haung)*

## To assess the introduction of meat black-goat as breeding stock in Peng-Hu

Two male and six female goats, which were selected by the results of blood test and body type data, were introduced into Penghu Island from Hengchun Research Station in the year of 2011. The ages of goats were about eight months old. The body weights of male and female goats were 22 kg and14~22 kg, respectively. It seemed that they have adapted the environment of Penghu Island. The estrus rate of female goat in 2011 was better than that of in 2010 (85.7% vs. 42.85%). Meanwhile they delivered 10 kids in the year of 2011. The birth weight and weaning weight of male and female kids were 2.3 kg, 1.5-2.4 kg and 11.5 kg, 12.3 kg, respectively. The daily gains of male and female kid were 0.102 kg and 0.113 kg, respectively. The kidding rate, singling rate and twinning rate were 142%, 57.15%, 42.85%, respectively. Four does from Hengchun Research Station and eight does from Hualien Breeding Animal Propagation Station have mated and will deliver their kids around the March of 2012.

(*M. C. Lu and C. C. Wu*)

Jian black-goat from Hualien Breeding Animal Propagation Station

Taiwan black-goat kids

Taiwan black-goat from Hengchun Research Station

Taiwan black-goat kids

## Phylogogenetic and genetic diversity analysis of sambar deer

The primer sets specific to cytb gene and mitochondrial D-loop region of deer were designed and used to amplify 32 sambar deer DNA. After purification, the PCR products were sequenced by an automatic DNA sequencer. The sequences of cytb gene and D-loop region from 30 samples were used to construct phylogenetic trees, respectively. Based on cytb gene analysis, the phylogenetic tree had two clusters; one cluster was composed of 27 sequences, the other 3 sequences. Based on the mitochondrial D-loop sequence analysis, the 30 sequences were divided into five clusters. The result indicates that the evolution rate of D-loop region is faster than that of cytb gene. Besides, the genetic diversity analysis of 32 sambar deer was conducted by using 16 microsatellite markers. The values for observed heterozygosity (Ho), expected heterozygosity (He), and polymorphism information content (PIC) among all loci were in the range of 0 – 0.84、0 – 0.73 and 0 – 0.68, respectively. Furthermore, the mean values for Ho, He, and PIC were 0.32 ± 0.24、0.38 ± 0.27 and 0.34 ± 0.25, respectively. The result indicates that the genetic diversity of this sambar deer population is low.

*(R. B. Liaw, R. J. Chern, H. L. Lin, S. R. Kang, C. H. Wang, M. P. Cheng and M. C. Wu)*

## The evaluation of "The Tall Pig" in Taiwan

The selection of large-frame breed pig could increase the meat quantity of their offspring. The aims of this study is to evaluate body conformation of breed pig for testing growth performance in pig performance testing station of National Animal Industry Foundation from July, 2005 to October, 2010. The breed pigs were measured body conformation which the top one third ranking champions by judging the body type in seven months old, and growth performance certified in six month of age. The item of the body conformation were to measure body length, body height, chest girth, depth, width, rear width, and girth of limb. There are total 2296 breed pigs to be judged body type, including Landrace, Yorkshire and Duroc, and all of them, 572 heads, to be measured the body conformation. The champion pigs of judging body type and growth performance certified were measured sum of length which including body height, body length and rear width, the sum of more than 270 cm are honored as " The Tall Pig". The results were showed that 150 Landrace, 44 Yorkshire, and 325 Duroc (total 519) were champion pigs, the average total length (mean ± S.D.) are 257.9 ± 6.5, 255.7 ± 6.9 and 255.6 ± 5.1 cm, respectively. There are five Landrace (3.3%), two Yorkshire (4.5%) and two Duroc (0.6%) boars have the highest honor "The Tall Pig" when using those records.

*(Y. Y. Lai, M. H. Hsieh, P. H. Wang, M. C. Wu, Y. Y Sung)*

## Selection for new breed of Taiwan Duroc pig: color pattern of coat and genotypic frequencie

The selection object for new breed of Taiwan Duroc was to develop high adaptability and reproductive performance boar by crossing and up-grading matting. Estrogen receptor (ESR) gene has two alleles, A and B. Literature indicated that BB homozygotic sows had more litter size than AA homozygote did. Thus, allele B of ESR gene is generally recognized as a favorable allele. The purpose of the present study was to introduce allele B into new breed of Taiwan Duroc. Thus, three phase of breeding scheme were carried out in this project. First, we used the KAPS black boars (BB homozygote) and Duroc sows (AA homozygote) to generate F1 progeny (D 50% × K 50%). Second, the black F1 boars were selected and mated with Duroc sows to generate R1 (D 75% × K 25%, DDK). Finally, the red R1 boars were selected and mated with Duroc sows to generate R2 (D 87.5% × K 12.5%, DDDK). In addition, the color pattern of coat and the ESR genotyping data were collected. The proportion of red coat color was 0, 52.1 and 100% in F1, R1 and R2, respectively. The results demonstrated that the black coat color was dominant and red coat color was recessive. Furthermore, as expected, the proportion of AB heterozygote was 100, 54.7 and 70.5% in F1, R1 and R2, respectively. The R2 progeny with AB heterozygote had been selected for further self matting. We expected that could successfully generate BB homozygotic progeny from R2 and introduce the favorable B allele into new breed of Taiwan Duroc.

*(C. H. Chen, N. T. Yen, Y. C. Chen, M. T. Chang, M. C. Huang and M. C. Wu)*

## Evaluation of feet and legs of breeding pigs

Feet and legs problem is one of the three major reasons for culling breeding pigs. Evaluation of feet and legs need a scoring method and this study attempted to set up a scoring method for pig selection system of Taiwan. For setting the linear scoring method of front and rear feet-legs, a total of 49 Landrace boars of seven auctions from members of Formosan Farmers Association for Swine Improvement and 86 Landrace boars of six terms from the Central Performance Test Station of National Animal Industry Foundation were scored. At first, a scoring form was set up, 100 total points, including 40 points of front legs (knee, front-leg turning, pasterns and claws) and 60 points of rear legs (angle-hock joint, rear-leg turning, pasterns and claws). Then we organized the working team for scoring feet and legs in breeding pigs. The members are Mr. Liu Kuei Chu, Mr. Lin Ko Yu, Mr. Yen Nian Tsu, Miss Chen Chia Hsuan and Mr. Wu Lian Fu. Three representative team members would score for feet and legs of breeding pigs, and Mr. Liu Kuei Chu and Mr. Lin Ko Yu served as chief umpire and vice umpire respectively. The scoring results will promote the swine breeding industry to enforce the structure of pig's feet and legs, and the scored feet and legs data will join as one of the information in breeding pig auction in the future.

*(N. T. Yen, Y. C. Huang, C. H. Chen, K. C. Liu, K. Y. Lin, L. F. Wu, and M. C. Wu)*

## The study of sperm production performance test in breeding pigs and roosters

In Taiwan, growth performance test, artificial insemination and reproductive gene typing are adopted as selection of progeny of breeding stocks in early of 1990s. Hence, further to establish an evaluation system on sperm capacity in high meat quality populations of breeding pig and chicken, it will be beneficial to having improvement of better prolificacy on semen production of breeding animal selection program and reduce the cost of keeping sterile male. The purpose of this study is to establish a technique for evaluation of sperm quality and evaluate at least 1000 to 5000 sperms of test breeding animals as predictors in young breeding animal for selection. First, the semen diluted to 0.5×106 /ml will be mixed with specific dye and incubate at 37℃ for minutes, then analyze sperms with viability, acrosome and sperm membrane integrity, mitopotential, calcium level, chromatin structure,oxidation and bacterial count assay. The result shows that different indexes were found in different pig species and also in individual but same species. The criteria of this semen evaluation technique may need further study.

*(T. Y. Kuo, H. L. Lin, H. L Hsing, D. Y. Lin, Y. Y. Lai, N. T. Yen, C. H. Chen, R. B. Liaw, C. H. Wu and M. C. Wu )*

## Analysis of semen performance in Taiwan Duroc boars followed by upgrading breeding

Fertility can seriously affect the competitiveness of pig industry. Development of semen quality evaluation is helpful for sow's fertility. The purpose of this study was to evaluate the semen quality of Taiwan Duroc boars followed by upgrading breeding. We used the sperm counter and flow cytometry to observe semen quality, including semen volume, sperm concentration, total sperm count, mitopotentia and sperm motility, of R1 (Duroc sow × KHAPS black boar, N = 4) and R2 boar (Duroc sow × R1 boar, N = 4). Semen quality evaluation was performed for 2 to 4 times per boar. The average evaluated-day-old of R1 and R2 boars were 604.38 ± 53.12 and 578.93 ± 57.81 day, respectively. The semen volume, sperm concentration, total sperm count, mitopotentia and sperm motility were 185.63 ± 71.19 (mL), 3.17 ± 0.90 (108/mL) , 588.66 ± 49.70 (109), 13.77 ± 5.65 (%) and 75.92 ± 18.23 (%) in R1 boars; and 244.36 ± 127.69 (mL), 2.92 ± 1.00 (108 / mL), 713.70 ± 128.22 (109), 15.94 ± 10.33 (%) and 81.84 ± 9.64 (%) in R2 boars, respectively. The results showed that semen performance of the Taiwan Duroc boar were obviously increased after upgrading bleeding and were needed to evaluate in the future programs.

*(C. H. Chen, T. Y. Kuo, M. T. Chang, N. T. Yen, Y. C. Chen, M. C. Chan, M. C. Huang and M. C. Wu)*

## The growth performance of Taiwan Duroc hybrids followed by upgrading breeding

The purpose of this study was to investigate the performance of the Duroc hybrids in upgrading breeding programs. In this study, we used 58 ♂ R1 (D 50% × K 50%), R2 35 ♂ (D 75% × K 25%,) and R3 (D 87.5% × K 12.5%) 40 ♂, 35♀. we collected The body weight at 70 days old (BW70), The body weight at 150 days old (BW150), average daily gain from 70 days to 150 days (ADG), feed efficiency (FE) and backfat thickness (BF) as growth performance. Our results were the BW70 (mean ± SD), BW150, ADG, FE and BF of R1 male, R2 male, R3 male and R3 female were 30.81 ± 3.18, 29.66 ± 3.82, 29.90 ± 3.38 and 30.35 ± 3.37 kg, 94.07 ± 9.69, 95.01 ± 13.26, 95.58 ± 10.60 and 86.10 ± 7.64 kg, 0.80 ± 0.11, 0.82 ± 0.15, 0.83 ± 0.12 and 0.71 ± 0.09 kg, 1.96 ± 0.21, 2.02 ± 0.22, 2.12 ± 0.16 and 2.06 ± 0.18 cm, respectively. The preliminary results showed that there were no significant difference among the growth performances of R1, R2 and R3. Therefore the male and female hybrids in the next-generation of upgrading programs with BW150 more than 110 and 90 kg, respectively could be further selection.

*(C. H. Chen, N. T. Yen, Y. C. Chen, C. B. Hsu, C. H. Wang, M. T. Chang, M. C. Huang and M. C. Wu)*

## Assessment of boar sperm quality by flow cytometer

The fertility of sperm is related to its structures such as the integrity of sperm membrane, acrosomal membrane, mitochondrial membrane, chromatin and the calcium reservation inside the cytoplasm. Flow cytometer can be used to determine cell structure and the composition of cytoplasm and could be a very useful equipment to determine the semen quality. The purpose of this study was to develop an evaluation system of sperm quality for establishing the database of selection standards for boars. For determination of sperm quality of the boars from Formosan Farmers Association, the semen of each boar was collected and stored at 17℃ and diluted to 0.5×106 /mL. After mixing with specific dyes, the semen was incubated at 37℃ for couple minutes before analyzing. The results showed that the sperm characteristics of boars for auction (n = 205) and not auction (n = 85), respectively, were as below (%): sperm membrane integrity (75 ± 23%; 69 ± 27%), intact acrosome (40 ± 22%; 36 ± 25%), depolarized mitochondria (28 ± 18%; 31 ± 20 %), calcium mean level (443 ± 98; 443 ± 89 ), high calcium level sperm (83 ± 20%; 83 ± 17 %), intact chromatin structure (94 ± 7%; 92 ± 11% ), oxidation degree (71 ± 17%; 67 ± 21%).

*(T. Y. Kuo, H. L. Lin, M. C. Chan, S. Y. Lee, N. T. Yen and M.C. Wu)*

## Establishment of provision of minimal disease minipigs

To meet both the quality and quantity demands for laboratory minipigs, which can be used for biomedical research and the biotechnology industry, Taitung Animal Propagation Station was requested to produce and provide minimal disease minipigs. Guidelines and standard operation procedures were established and implemented into the animal care and veterinary programs, and the facilities were renovated to meet the needs for minipigs production. There were 500 minipigs supplied for 24users as laboratory animals in 42 biomedical research projects in 2011. A farrowing house and a house for breeding herd were renovated to meet the needs of minipigs production. For the sake of improving animal welfare anesthesia was administered during castration operations and soft music was collected and constantly played to pacify the moods of the animals. Nine specific pathogens were monitored per season. And the standard operative procedure of animal transportation and record form were adjusted to meet the requests of animal welfare and related regulations.

*(H. P. Chu, C. W. Chang, C. C. Chang, J. Y. Lin and J. K. Chen)*

## Germplasm management and genetic diversity maintenance of Lanyu Pig

To avoid the inbreeding regress of Lanyu conserved herd, part of particular individuals were arranged in five mating groups that according to their genetic variation, genetic distance and different haplotype of mitochondrial DNA, and the offspring's genetic diversity will also be checked and assessed to form a suitable management policy to maintain genetic diversity. For the purpose of promoting efficiency of conservation, the technologies of artificial insemination with fresh semen and frozen semen were established successfully in 2010.

*(C. W. Chang, C. C. Chang, J. K. Chen J. Y. Lin and H. P. Chu)*

Lanyu pig nursing situation

Lanyu pig

## Establishment traceability system and information website on biomedical minipig provision by introducing RFID technology

Using technology of radio frequency identification, RFID, a web based Minipig traceability system will be available for public through an automation project. The system was based on 134.2 KHz RFID piglet ear tag, RFID reader, wireless mass data collection device and wireless internet access environment. Farm manager can use remote web programs on farm for real-time data audit. Data transfer was through dual-band wireless broadband router, enterprise network firewall, fast Ethernet switches, outdoor omnidirectional antennas and boosters which built the on farm WIFI wireless internet access environment. Remote MS SQL server database is from Taiwan Animal Germplasm Information Network. The Minipig English and Chinese website (http://minipigs.angrin.tlri.gov.tw/) is set by XOOPS, a platform of eXtensible Object Oriented Portal System, which will provide accurate and instant traceable information of Minipigs for biomedical institutes. Livestock Research Institute is constructing Minipigs breeding and management system energetically to improve the quality and quantity of supply, and the web site set up can enhance the international visibility of Taiwan laboratory miniature pigs.

*(H. P. Chu, C. W. Chang, J. Y. Lin, J. K. Chen and C. C. Chang)*

RFID ear tags read by signal reader


The accurate and instant traceable information of Minipigs for biomedical users was established by introducing technology of radio frequency identification, RFID

## The selection and registration of Binlang pig (Lanyu 400) for biomedical research

Due to minipigs are physiologically and anatomically similar to the human body, they are suitable for the development of a variety of models in biomedical research. Native Lanyu breed was introduced in 1980. After more than three decades of breed conservation and selection for experimental purposes, a new minipig breed, Binlang, with white coat color from their black ancestors was bred and registered in 2011 by Taitung Animal Propagation Station. The breed named Binlang take their name from Binlang village in Puyuma Township in Taitung, the location of the station at which they have been bred. Their white appearance is especially useful for animal model experiments related to biomedical research such as plastic and transplant surgeries and clinical testing of cosmetics.

*(H. P. Chu, J. W. Hong, C. W. Chang, J. Y. Lin, J. K. Chen and M. C. Wu)*

Binlang pig

## Effect after 6 years interrupt selection on the duration of fertility of brown Tsaiya ducks

The objective of this experiment was to compare the duration of fertility in the intergenetic crossbreeding of ducks after 6 years interrupt selection. A total of 360 female brown Tsaiya ducks (240 LRI No. 2 ducks from cease of selection for fertility duration and 120 control ducks) were used as experimental animals. A total 40 male Muscovy ducks (LRI No. 1) were used as breeding birds. Female ducks were artificial inseminated once at 26 weeks of age using 10-15 males' mixed semen. Eggs are collected for 18 days consecutively after inseminated 0.05 mL semen for each bird. Eggs for 9 days are incubated for fertility and hatch rate. Eggs number, fertility eggs, hatched eggs, death of embryo and longest fertility day are recorded. The results indicated that the ducks after 6 years interrupt selection had significantly higher number of fertility eggs, hatched eggs, death of embryo at the 7th day and the longest fertility than the control group ($P < 0.05$). No difference was found in death of embryo at the 26th day and death at hatch.

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

## Effect after 5 years interrupt selection on the growth and egg production performance of brown Tsaiya ducks

The objective of this experiment was to compare the growth and egg production performance of brown Tsaiya ducks after 5 years interrupt selection. A total of 356 female brown Tsaiya ducks (166 LRI No. 2 ducks from cease of selection for fertility duration and 190 control ducks) are used as experimental animals. A total 164 male brown Tsaiya ducks (78 LRI No. 2 ducks and 86 control ducks) are used as breeding birds. Wing was tagged individually. Feed was supplied ad libitum. The age, body weight and egg weight at the first egg; egg number and egg weight at 40 weeks of age; body weight and egg production performance at 30 and 40 weeks of age were recorded. The results indicated that the female and male ducks after 5 years interrupt selection had significantly lighter body weight at 30 and 40 weeks of age than the control group ($P < 0.05$). Ducks after 5 years interrupt selection had significantly lighter body weight at first egg and egg weight at 40 weeks of age ($P < 0.05$). No difference was found on age at first egg, first egg weight and egg number at 40 weeks of age.

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

## Genetic analysis for heterozygosity in conserved populations of duck

One hundred and twenty individuals (30 drakes and 90 ducks) were selected from the germplasm preservation population for the 15$^{th}$ generation of Brown Tsaiya ducks, 12$^{th}$ generation of White Tsaiya ducks and 12$^{th}$ generation of black Muscovy ducks. The average body weights of the 15$^{th}$ generation brown

Tsaiya drakes and ducks were 1.21 and 1.29 kg respectively at 20 weeks of age. The fertility rate and hatchability rate of the 14th generation brown Tsaiya ducks were 93.2% and 77.1%. The average body weights of the 11th generation White Tsaiya drakes and ducks were 1.5 and 1.49 kg respectively at 20 weeks of age. The fertility rate and hatchability rate of the 11th generation White Tsaiya ducks were 85.1% and 79.3%. The average body weights of the 12th generation black Muscovy drakes and ducks were 3.32 and 1.93 kg respectively at 20 weeks of age. The fertility rate and hatchability rate of the 11th generation black Muscovy ducks were 83.9% and 69.9%. The genetic polymorphisms in 30 black Muscovy ducks were estimated by using ten microsatellites of Tsaiya ducks. A total 45 alleles were observed with an average of 4.5 per microsatellite locus. The observed and expected heterozygosity of those polymorphic markers ranged from 0.23 to 0.67 with an average number of 0.51 and 0.35 to 0.83 with an average number of 0.62, respectively.

*(H. C. Liu, L. Y. Wei and J. F. Huang)*

The germplasm conserved black Muscovy drake standing at wire floor

## Trait selection and application of high feed efficiency in brown Tsaiya ducks

The objectives of this study were to investigate the feed intake, egg mass, body weight and delta body weight of Brown Tsaiya ducks at 34 to 37 weeks of age and to evaluate the residual feed consumption for further selection. Ducks were individual caged after 12 weeks of age, feed consumption, egg mass, body weight and body weight change were recorded at 34 to 37 weeks of age. The results indicated that average feed consumption for 4 weeks, average egg mass for 4 weeks, average body weight for 4 weeks and average body weight change for 4 weeks of selection line ducks were 3840 ± 418 g, 1357 ± 311 g, 1336 ± 185 g and -13 ± 82 g, respectively. For the control line ducks were 3911 ± 433 g、1252 ± 284 g、 1329 ± 212 g and -4 ± 145 g, respectively. The average residual feed consumption for selection line and control line ducks were -143 ± 172 g and 127 ± 210 g, respectively. Phenotypic correlation estimated between residual feed consumption and feed intake was high, but low correlation with egg mass, average body weight average body weight change and egg number at 52 weeks of age. Even for the correlation between residual feed consumption and feed conversion rate was only 0.15. Data regarding of feed consumption, egg mass, body weight and variance of body weight at age from 34 to 37 weeks will be recorded for three consecutive generations, and then the selection efficiency evaluation will be conducted.

*(H. C. Liu, L. Y. Wei and J. F. Huang)*

The feed consumption of Brown Tsaiya in individual cage was recored

## Establishment of supply system for minimum disease-free Muscovy duck herd

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 production of duck Parvovirus vaccine, development of Pasteurella anatipestifer (Riemerella anatipestifer) vaccine and requirement of terminal sires in 3-way crossbreeding for production of mule duck and pure breeding. The minimal disease Muscovy duck herd (L305) has been selected from L302G13 (white Muscovy duck LRI 1) for 7 generations. The laying performance of age at first egg, number of eggs laid up to 40 and 52 weeks for L305G6 and L302G13 were 255 vs. 264 days, 14 vs. 12 and 70 vs. 67, respectively. The body weight at 10 weeks of age for male and female ducks of L305G7 and L302G13 were 4023 vs. 4144g and 2526 vs. 2536g,

respectively. Overall, the performances of L305 wouldn't be influenced by selection and disease screen procedure. L305G7 are raising in indoor system and have been move to individual duck house at 24 weeks age. After improving the bio-security measures and intensive disinfection, the titer of serum neutralization (SN) test for parvovirus had decreased. These embryonic eggs from L305G7 can produce 3.75 bottles (1000dose/bottle) of live parvovirus vaccines per egg in average.
*(L. Y. Wei, H. C. Liu and J. F. Huang)*

Rearing environment of MD Muscovy duck

## Exchange and cooperation between Taiwan and France to improve poultry's production efficiency

This plan was aimed to invite the experts in disease resistance in poultry breeding, feed efficiency selection, duck management and feeding techniques and frozen semen techniques of the French National Agricultural Research Institute (INRA) to visit Taiwan. During the visiting procedure we invited the France experts to give 4 lectures in Livestock Research Institute, Duck Association Taiwan, Department of Animal Science and Technology of National Taiwan University and Ilan Branch, Livestock Research Institute, respectively. Through the exchange of research experiences in France, we can shorten our exploring time in disease resistance in poultry breeding, feed efficiency selection of ducks, indoor raising and frozen sperm development and to solve the faced problems in poultry industry. We expect that through the international cooperation we can raise our visibility in study of ducks in the international community.
*(C. H. Cheng, J. F. Huang, C. H. Su, H. C. Liu, L. Y. Wei and Y. F. Lin)*

The INRA researchers (Dr. Elisabeth Blesbois, Dr. Gérard Guy and Mr. Benjamin Basso) visited Ilan Branch, LRI.

## On farm test for growth performance and hatching rate in native chicken breeding flock

In order to help native chicken breeding farms to establish the techniques of on farm test for growth performance and hatching rate in their breeding flock. Cooperating with those of native chicken breeding farms under the program of the Innovation Incubator Center of Livestock Research Institute, we proceeded on farm test. Body weight of red feather native chicken was measured before one week of marketing age. Record of hatching rate (chick number/egg number of hatchery) of individual hen was collected from 32- 37 week of age. Body weight at 8-week-age in male and female native chickens were 1822 ± 220 g and 1507 ± 168 g (mean ± SD), respectively. Their hatching rate is 73.1 ± 28.7% (mean ± SD). There is significant difference in hatching rate among six lines of this flock ($P < 0.01$). Therefore, we can select chickens with good growth performance and hatching rate of their parent as candidate breeding chicken according to records of on farm test.
*(S. L. Hsing, D. Y. Lin and M. C. Wu)*

## Association study of chicken prolactin gene and broodiness

Science National Pingtung University of Science and Technology Chicken broodiness is considered as one of the major factors that decrease the potential of egg production. In order to set up a F2 design reference family for mapping of broodiness, the F1 hybrid progenies was produced by reciprocal crosses between LRI native chicken inbred line 9 ( LRI-L9) and Leghorn, and F2 progenies was produced by fullsib mating of F1. Records of genotyping of DNA extracted from blood merged with broody records were used to explore the association between broodiness and genotype. Prl of PCR-SSCP has three genotypes. The genotype frequency of MM, MN and NN in LRI-L9 were 33.3%, 36.4% and 30.3%, respectively. But, all leghorns were NN type in the collected samples. The G0 data showed a strong association between breed and genotype ($P < 0.001$). Eighty percent of hens of F2 don't express broody behavior. The average broody days of broody hens, with more than three days continually broody records, were 19.6 days. The link between Prl genotypes and broodiness was also significant in the F2 data set ($P < 0.01$) and hens with NN genotype were less broody than those hens with MN genotype or MM genotype ($P < 0.01$).

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

## Association study of chicken estrogen receptor gene and early maturity in hen

F2 design reference family was set up a for chicken gene mapping, the F1 hybrid progenies was produced by reciprocal crosses between LRI native chicken inbred line 9 ( LRI-L9) and Leghorn, and F2 progenies was produced by fullsib mating of F1. Records of genotyping of DNA extracted from blood merged with the age at first egg (AFE) records were used to explore the association between maturity and genotype of estrogen receptor (ESR). Three genotypes (EE, EF and FF) of ESR were detected by PCR-SSCP. The genotype frequency of EE, EF and FF were 0%, 3.0% and 97.0% in LRI-L9, and 61.1%, 33.3% and 5.6% in white Leghorn, respectively. The G0 data showed a strong association between breed and genotype ($P < 0.001$). The average AFE of hens in F2 was $168 \pm 14$ days. The Range of AFE of hens was 127 to 203 days. There was significant difference among genotypes in AFE of hens ($P < 0.05$). Hens with heterotype (EF) of ESR were earlier mature than those hens with homotypes (EE and FF).

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

## Evaluation of pullorum disease filimination in red feather native chicken breeding flocks

Pullorum disease is caused by Salmonella Pullorum and mainly spreaded by horizontal transmission or infected eggs. Acute outbreaks occur in farms quit often, and the affected chick becomes no symptomatic carrier and infects the chicks via eggs. Therefore, eliminating the pullorum disease remains an important goal in poultry industry. The aim of this study is to control and eradication of Pullorum disease to increase uniformity and efficiency of production of native chicken farms. This study use flocks of native chicken provided by the breeding farm under the program of the Innovation Incubator Center of Livestock Research Institute. Blood samples, 1 to 2 mL, were from wing veins about of 15 to 20 week-old in each generation, and then assayed in rapid whole-blood plate agglutination test. All the positive animals will be culled. The results of the positive rate are 18.79, 7.66, 63.50, 9.32, 14.29, and 16.30% respectively in G0, G3 to G7 of farm A; and are 24.2, 7.66, 11.30, 25.40, and 26.28% respectively in G0 to G4 of farm B. However, positive rate did not decline after culling the positives in generations. This naturally gives rise to the speculation that perhaps the detection reagents expired of farm A in G4, therefore after that the reagents of farm A of G6 and farm B of G3 were changed. Farm B flocks in G4 were removed to the other location. In summary, the differences of antigen doses, serotypes, management, and environment might cause the influence of the higher positive rate of pullorum disease in this study.

*(S. L. Hsing, D. Y. Lin, Y. Y. Lai and M. C. Wu)*

## Inbreeding coefficients of Taihsu No. 1 Country chichen

Taihsu No. 1 is a Single crown and slim shank country chicken, collected from several locations of Taiwan and and purified by 1.5 decades, from1985 to 2011. The inbred Native Chicken, Taihsu No. 1 has four lines, L7, L9, L11 and L12, passed nomination of new plant and animal species of Agriculture and Forestry of Taiwan Provincial Government in 1997. Inbreeding coefficients of this study are of the birds from 1986 to 2011 of four lines, L7, L9, L11 and L12. There are 12,654 total of L7 (♂ 4318 birds, ♀ 8336 birds); L9 has 13280 (♂ 4772 birds, ♀ 8508 birds); L11 has 17034 (♂ 5712 birds, ♀ 11322 birds) and L12 are 13615 (♂ 4962 birds, ♀ 8653 birds). The inbreeding selection was one generation per year by full-sib mating practiced from 1986 t0 2006. Inbreeding coefficients of L7, L9, L11 and L12 at 1987 were 0.2376 ± 0.0374, 0.2320 ± 0.0440,0.2175 ± 0.0550 and 0.2487 ± 0.0129, which increased to 0.7578 ± 0.0949, 0.7088 ± 0.1368, 0.6089 ± 0.1275 and 0.7298 ± 0.0560 at 2006 . Breeding strategy was changed to enhance the egg production from 2008 which selection enhanced on egg production performance, full-sib mating ignored. Inbreeding coefficients of L7, L9, L11 and L12 were 0.6024 ± 0.1567,0.6122 ± 0.1600,0.4914 ± 0.1584 and 0.6569 ± 0.1673 at 2008 and decreased to 0.5162 ± 0.0093, 0.5220 ± 0.0191, 0.4439 ± 0.0337 and 0.2422 ± 0.0448 at 2011.Results showed inbreeding of L12 decreased most in four lines, however, L7, L9 and L11 decreased slightly.

*(Y. Y. Lai , S. L. Hsing, C. S. Wu, H. R. Tsai and D. Y. Lin)*

## Improvement of egg number in LRI-1 native chicken

In order to improve egg number for Taiwan country chicken breeding farms, establishing the standard operating procedures is necessary. The platform was demonstrated by inbred selection. Egg number was the only major trait on the illustration selection. High egg number hens were selected for breeding from four lines of Livestock Research Institute (Inbreed Lines, L7, L9, L11 and L12). After four generations of selection, significant differences of egg number up to 40 weeks of age were detected among the generations (P <0.001). Egg numbers of G4 generation are higher than G0 generation in the four lines, L7, L9, L11 and L12, which increased 39.1% (28/71.6), 51.5% (30.6/59.4), 37.8% (27.3/72.2) and 36.1% (23.7/65.7) of egg number, respectively. Average body weight of 16-week-old of chicken and egg weight at 40 weeks of age of hens differs significantly between generations (P <0.001). Furthermore, the average of body weight at 16-week-old of chicken and Egg weight at 40-week-old of hens in the G4 generation did not decrease with the increased egg number, but have significantly improved. Both traits of the G4 generation are higher than the G0 generation. Based of small population pedigree mating, selection of egg number on this illustration can achieve the breeding goals, increase egg number at 40 weeks of age and body weight at 16 weeks of age. The selection practice steps can be the standard operating procedures for breeding farms.

*(D. Y. Lin, Y. F. Lin, S. L. Hsing, H. L. Lin, Y. Y. Lai, S. L. Liu, C. M. Hung and M. C. Wu)*

## Applying EASYCYTE to estimate quality of red feather native chicken semen

To establish a comprehensive semen quality evaluation system and to enhance the efficiency of breeding and productivity of native chicken, this study use semen samples of native Taiwan red feather chicken provided by the breeding farm under the program of the Innovation Incubator Center of Livestock Research Institute to develop a evaluation system on quality and productivity of Taiwanese rooster semen. The objective of this study mainly examines semen: viability (survival rate), acrosome and sperm membrane integrity, mitochondria integrity (mitopotential), calcium level and bacterial count. The semen of 12 red feather native chickens about 25 weeks old from the native chicken breeding farm was analyzed by EASYCYTE. We found: the 50th percentile average and maximum viability of our sample are 94.90% and 98.21% respectively. Similarly, the corresponding 50th percentile average and maximum value of intact acrosome and sperm membrane of the sample were 98.33% and 99.06%

respectively; the intact mitochondria are 99.12% and 100% correspondingly; with calcium level of 257.38AU and 188.82AU and the bacterial count of 2.4 x $10^5$ /mL and 5 x $10^4$ /mL respectively. The 50th percentile average and maximum value of the sample can be used as the selection criterion for roosters breeding. The findings can further be used to evaluate and estimated sperm productivity and performance and can be applied to select breeding roosters.

*(S. L. Hsing, H. L. Lin, D. Y. Lin, Y. Y. Lai and M. C. Wu)*

## Using dual frequency RFID reader to recording laying eggs of hen

To achieve less data entry costs and fewer data entry error, a two frequency RFID readers is used to read 125kHz and 134.2kHz RFID electronic tags for cage identification (ANIMAL POSITION) and type of eggs (OPERATION ACTION) with recorded date-time. The commercial reader with data transfer software, egg collected data can be transferred to computer or data storage device by bluetooth or USB connection. After EXCEL sorting and LOOKUP functions, the recording system of RFID readers can eliminate manual data entry costs and time and avoid errors arising from manual input, which can simplify the procedure of egg collection. In the future, breeders can use multi-band RFID reader and associated software to achieve data collection of the ids of the manager, animal position and recording date-time and operation action, such as animal medication, feed and feeding and other management information for animal breeding.

*(D. Y. Lin, Y. C. Huang, S. C. Lee, Y. Y. Lai, C. H. Wu and M. C. Wu)*

## Study on Improvement of Production Performance of Silky Chicken

This experiment was to improve growth performance and disease resistance of white silky chicken (SW) and black silky chicken (SB) via breeding and nutrition. The average hatching weight, body weight at 10 weeks of age and body weight at 20 weeks of age for SW and SB were 27.4 ± 2.56 and 30.8 ± 3.82 g, 566 ± 93.5 and 627 ± 131 g, and 1186 ± 227 and 1463 ± 295 g, respectively. The silky characteristics were lack of beard. Hairy legs rate in SW and SB were 98.5% and 7.51%, respectively. A total of 360 eight-week black silky chicks from Livestock Research Institute (LRI) were divided into 6 groups. Each group had 60 birds, and was allocated into 3 pens (3 replicates) with half males and half females. The experiment was conducted as 3×2 factorial design. The corn-soybean diets were formulated to the levels of 15, 17 and 19% crude protein (CP) and 2,800 and 3,000 kcal/kg metabolizable energy (ME). Water and feed were fed ad libitum. Body weight, feed intake were recorded at 8, 12, 16 and 18 weeks of age. The results showed that birds fed diets with CP 17%, ME 3,000 kcal/kg and CP 17%, ME 2,800 kcal/kg had the highest average body weight at 12 and 16 weeks of age, respectively. Birds fed diets with CP 17%, ME 3,000 kcal/kg had highest average body weight at 20 weeks of age. Compensation growth was found on the growing period. The highest body weight gain was 982 g with CP 17% and ME 3,000 kcal/kg while the lowest average body weight gain was 905 g with CP 15% and ME 2,800 kcal/kg among 8 to 20 weeks of age. CP 19%, ME 3,000 kcal/kg had the best feed efficiency (3.66) and CP 15%, ME 2,800 kcal/kg had the worst (4.54) during 8-12 weeks of age. Feed efficiency was between 5.30-6.06 during 12-16 weeks of age, and 7.09-9.45 during 16-20 weeks of age. The results suggest that silky chickens fed with practical diets with CP 17% and ME 3,000 kcal/kg have better performance without significant difference.

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

## Selection of female white silky chicken for egg production performance

One hundred and sixty two hens were caged for determination of egg production performance. The results indicated that age, body weight, egg weight at the first egg were 157 day, 1,247g and 31.8g, respectively. Egg weight, body weight and egg number at 40 weeks of age were 41.1 g, 1,439g and 100 eggs, respectively. The estimated heritability in egg number, body weight and egg weight at 40 weeks

of age were 0.31, 0.84 and 0.58, respectively. Body weight and egg weight at 40 weeks of age had medium to high heritability. Egg number at 40 weeks of age had medium heritability. The estimated heritage relationship in egg number at 40 weeks was medium and positive with body weight (rg = 0.34), low and negative with average egg weight (rg = -0.18); in body weight at 40 weeks was medium and positive with egg weight (rg = 0.46). Twelve males and 12 females of white silky chickens were randomly selected for determination of slaughter performance. Of which three males and 3 females were determined the composition of breast muscle. The results indicated that the average slaughter rate was 78.2%. The ratios of slaughter in breast, leg, head and neck, wing, back and legs were 20.0%, 28.1%, 13.7%, 12.9%, 19.4% and 5.0%, respectively. The nutrient contents of breast in water, crude protein, crude fat, crude ash, gross energy, calcium, zinc and iron were 73.6%, 24.1%, 0.22%, 1.22%, 1,367 kcal/kg, 49.2 ppm, 7.2 ppm and 11.9 ppm, respectively. The results can be used for the improvement of egg production performance of silky chickens.

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

## Germplasm Management and Genetic Diversity Maintenance in LRI Native Chicken Populations

The project is conducted to obtain the pedigree data of small preserved populations of native chicken, to measure the body weight at 0、16 and 40 weeks, and to select the PD-free line to serve as chicken bred. Preserving the genetic resources in small live population of four inbreed lines of Taiwan native chicken, L7, L9, L11 and L12. The growth traits and reproductive traits will be monitored to ensure that the characteristics of the preserved populations are maintained. To prevent from chicken diseases, we will assay serum antibody titer and screen the Pullorum Disease. This study will be expected to realize the immunity against the diseases of chicken and the data can serve as the reference for poultry feeders in using medicine and vaccination. The results of the experiment indicated that the antibody titers of all the chickens after vaccinated programs had been protected for the Newcastle disease (ND), Infectious laryngotracheitis (ILT), Infectious Bronchitis (IB), and Reovirus (REO). The percentage of positive reactivity of PD at the 10 and 20 weeks old of chickens were 10.5% and 12.9%. At the 16 weeks, the body weight of L7, L9, L11 and L12 of male and female were 1986.4 ± 199.1g and 1212.4 ± 164.6g, 2067.0 ± 264.1g and 1323.8 ± 235.6g, 2071.2 ± 153.9g and 1188.2 ± 146.5g, 2055.7 ± 294.2g and 1292.7 ± 147.6g. The best egg number were 70 eggs of L12 up to 40 weeks of age.

(*M. J. Lin, S. R. Kang, and C. H. Wang*)

## Evaluation of Genetic diversity of conserved Chinese geese by microsatellite markers

The objective of this study was to investigate the genetic diversity of the conservative population of Brown and White Chinese geese using microsatellite genotyping. A total of ten microsatellite markers were used to genotype 106 Brown Chinese geese and 118 White Chinese geese of Changhua propagation station, Livestock Research Institute. The values for allele number, observed heterozygosity (Ho), expected heterozygosity (He), and polymorphism information content (PIC) of both lines of geese among all loci were in the range of 1- 6 vs. 2 - 5, 0 - 0.642 vs. 0 - 0.712, 0 - 0.663 vs. 0.014 - 0.683 and 0 - 0.598 vs. 0.014 - 0.625, respectively. The mean values for allele number, Ho, He, and PIC were 3.0 vs. 3.5, 0.332 vs. 0.237, 0.401 vs. 0.331 and 0.342 vs. 0.291, respectively. The result also indicates that the genetic diversities of both Chinese geese populations are moderate. In the future, the parameters of genetic diversity can be referred to the reproduction administration of conservative populations.

*(R. B. Liaw, R. J. Chen, H. L. Lin, C. C. Hsiao, Y. S. Jia and M. C. Wu)*

## 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 the offspring of the second generation of high production of day old gosling line born in 2004. The reproductive performance including age, body weight and egg weight at the first egg, egg production and laying period would be investigated. The data of egg production and pedigree obtained will be analyzed with the statistics method of Best Linear Unbiased Prediction (BLUP). After that, 25 ganders and 100 geese selected will be bred at next breeding season. We expect this breeding program will improve the ability of egg production of geese after selecting 5 generations. When the high egg production line of white Roman goose is named as a new line in the future, we can 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 commercial goose farmers. Experimental results will be introduced with the productive benefit to commercial goose breeders and farmers. Geese feeding 85% of basal ration feed restriction and 85% of basal ration feed restriction plus 1.5 and 4.5 kg of grass had higher hatchability of fertilize egg than feeding basal ration ad libitum (67.8, 63.7, 66.1 vs. 54.1%). Therefore, in view of economic benefits and animal welfare, feed restriction accompany with green grass is a good way to promote fertility and accompany with green hatchability of geese.

*(M. J. Lin, S. C. Chang, K. C. Wu, Y. S. Cheng and Y. S. Jea)*

Beidou White Goose LRI-1

## Bacterial diversity of activated sludge treating slaughterhouse wastewater

The objective of this study was to investigate the bacterial diversity of activated sludge with different sludge retention time (SRT) to treat slaughterhouse wastewater. The microbial DNA of activated sludge samples from SRT 7, 14, 21 and 28 days were extracted directly using a commercial kit and bead-beating protocol, respectively. The 16S ribosomal RNA genes of bacteria from 4 activated sludge samples were amplified with bacterial specific sets of primers by PCR. The amplicons were ligated into TA cloning vectors to construct 16S rRNA gene libraries for DNA sequencing and bacterial diversity analyses. The 312 almost full-length 16S rRNA gene clones from 4 activated sludge samples were obtained. The results indicated that the bacterial profiles comprising of Acidobacteria, Actinobacteria, Bacteroidetes, Firmicutes, Gemmatimonadetes, TM7, Planctomycetes, Proteobacteria, Verrucomicrobia and unclassified Bacteria phyla differed in SRT samples. The most of these communities belonged to Proteobacteria phylum. In OTU analysis, the OTU percentage of SRT28- day sample was low to reveal that the bacterial profile tended towards simplicity, and Rhodobacter was the majority. The Rhodobacter sphaeroides is the most famous species within Rhodobacter genus to express various proteins.

*(R. B. Liaw, R. J. Chen, T. H. Hsiao, M. C. Wu and M. P. Cheng)*

# Animal Nutrition

## Application of low heat increment diet for sow under high temperature and high relative humidity environment

The aim of this experiment was to evaluate the effect of low heat increment diet on sow reproductive performance under high temperature and relative humidity environment. Experiment was conducted in two environmental chambers with the temperatures were daily constant 25℃ or cyclic 24-32℃. Sows in each temperature groups were provided with either basal diet, containing CP 15%, ME 3250 kcal/kg, or experimental diet, containing CP 13% and the lysine content was increased to the level of the CP 15% diet. Besides, 4% soya oil was added to experimental diet to substitute the corn used. The digestible lysine level was kept at 0.65%. Sows were moved into farrowing crate at 3-5 day post farrowing. The lactating performance of sow and growth of piglets were measured to determine the effects of ambient temperatures and lactating diets. Results showed that feed intake for sows under cyclic temperature group was reduced when compared to that of constant temperature group. The low feed intake also resulted in greater body weight and backfat loss for sows. There was no difference on piglet performance either in different temperatures or diet groups. The application of low heat increment diet did not improve sow reproductive performance or growth performance of piglets under high temperature condition.

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

## Evaluation of the effect of betaine on the lactating performance of sows under heat stress condition

The aim of this experiment was to evaluate the effect of dietary betaine supplementation on the improvement of reproductive performance for lactating sows under heat stress condition. A total of 28 Landrace lactating sows were allotted into four groups, 7 sows for each. The experimental design adopted 2 x 2 factorial arrangement of treatment with 2 ambient temperatures. i. e. daily cyclic temperature 24-32℃ and constant temperature 25℃, and two diets which were control lactating diet (c) and control added 0.5% betaine. On the 3-5d post farrowing, sows were moved to lactating crates in respective environment controlled chambers. Feed and water were provided *ad libitum*. Body weight and backfat thickness change of sows during lactating period were measured. Interval between weaning and rebreeding and survival rate of piglets were recorded also. The piglets of gain weight during lactating period were calculated. Blood samples of lactating sows at the beginning and the end of experiment were taken for determination of blood constituents. The result showed that there was no interactive effect of ambient temperature and betaine supplementation on the reproductive performance of sows and growth performance of piglets during nursing period. Sows raised under the cyclic ambient temperature reduced their feed intake and had longer ($P < 0.05$) interval between weaning and rebreeding. Sows had higher ($P < 0.05$) respiration rate under cyclic high temperature when compared to constant temperature. There were no difference on the body weight gain and survival rate of piglets nursed by the sows in the cyclic high temperature and constant temperature. Sows fed diet supplemented with betaine did not improve their reproductive performance, including interval between weaning and rebreeding. No supplementation effect of betaine was observed on growth performance and survival rate of piglets. In conclusion, the cyclic high temperature reduced the feed intake and increased the interval from weaning to rebreeding for lactating sows. The supplementation of betaine in lactating sow's diet did not improve the reproductive performance of sows either in cyclic high ambient temperature or in constant ambient temperature.

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

## Effect of *Ganoderma lucidum* supplementation on reproductive performance in sows

The aim of this study was to evaluate the effects of Ganoderna lucidum compounds on reproductive performance of postpartum of sows, including both of reducing the incidence of sow's metritis and improving nursing rate. Before the expected farrowing date month the sows of two treatment groups were fed with 1000 ppm and 2000 ppm *Ganoderna lucidum* compounds, and the doses were increased to 2000 ppm and 4000 ppm after farrowing, respectively. The results were showed that the nursing rate of lactation of the sows fed with *Ganoderna lucidum* compounds were higher than the control group, 85.90, 88.99 and 88.89 %, respectively. The interval from weaning to estrous of treatment groups was shorter than the control group, 6.40, 5.86 and 5.94 days, respectively. There was no significant difference on the incidence of metritis between each group and the interval from weaning to estrous of the treatment groups were shorter than that of control.

(*P. C. Nien, K. H. Lee, Y. C. Chang, C. M. Wang, C. L. Hu and Y. S. Jea*)

Sow feeding piglets situation

## Effects of high fibrous diets on the animal welfare and reproductive performance of pregnant sows

The aim of this research was to study the effects of feeding a high-fiber diet on the welfare and reproductive performance of pregnant sows. Those of Landrance × Yorkshire crossbred sows were divided into three groups, been given a traditional diet (2 kg/day) or a high fibrous diet at 4 or 5 kg/day. The related items of reproductive performance and the welfare of the sows were examined in the study. The results showed the increase in weight of pregnant sows with a high fibrous diet (5 kg/day) was significantly greater than the traditional group ($P < 0.05$). The ratio of living piglet, living growth of the piglets, daily weight gain of the piglets, weight loss of sows from pregnancy to weaning, and estrus days of sows after weaning did not significantly differ. The pregnant sows fed with a high-fiber diet increased the meal time and defecation volume. In addition, the diet improved the composition of the defecation and decreased the barking volume disturbing behavior of sows.

(*C. Y. Lin, T. C. Wan and S. F. Yan*)

Feces of the high fibrous diets

Feces of the conventional diet

## Comparison of liquid-type milk replacer and milk replacer mixed with vegetable gum or gelatin on weight gain of nursing pigs

This objective of this study was to assess liquid-type milk replacer and milk replacer blended with vegetable gum or gelatin on body weight gain of nursing pigs. Experimental animals adopted 3 litters of

newborn crossbred LYD piglets at 3 days of age, each litter was divided into 4 hd in lower bodyweight group (2hd fed with vegetable gum and 2 hd fed with gelatin), 2 hd in middle bodyweight group, and 4hd in heavier bodyweight group served as control group. Trial arrangement liquid-type milk replacer to feed middle bodyweight group, milk replacer blended with 1% vegetable gum or gelatin to feed lower bodyweight group, and heavier bodyweight group without supplying extra diet. The feeding schedule was at 9:00 and 15:00 a day and was last for 3 weeks. Supplementary milk replacer amount was respectively 3 g, 5 g, and 7 g from the 1st to the 3rd week per one animal for one day. The results showed that total gain weight in heavier bodyweight group was 2 times higher than in lower bodyweight group, and both of fed with milk replacer blended with 1% vegetable gum and fed with liquid-type milk replacer was equivalent to total gain weight during the whole period for 3 weeks (3.22 kg vs. 3.25 kg). The body weight gain of pigs between milk replacer blended with 2% gelatin group and 1% vegetable gum group were not significantly different for the first week, but there was significantly higher in fed with 1% vegetable gum group than in fed with 2% gelatin group or liquid-type milk replacer group during the period from the second and the third week. Therefore, to infer from the previous results suggested that milk replacer blended with 1% vegetable gum was better than milk replacer blended with 2% gelatin and liquid-type milk replacer to improve body weight gain of nursing pigs.

(*F. C. Liu and Y. C. Lin*)

## The effects of ambient temperature and glutamine on growth performance and blood metabolites of growing pigs

Heat stress affects livestock performance. The aim of this experiment was to investigate the heat relief effect of glutamine for growing pigs. A total of 18 head crossbred LYD pigs with body weight around 20 kg were allocated into 3 artificial climate chambers (block treatment, room temperature of 33℃, 29℃ or 25℃). In each chamber, diets containing 0% or 1% of glutamine were offered for 3 wks. On the first and last day of this experiment, blood samples were taken to measure the concentration of IgG and other metabolites. Feed intake and body weight of pigs were recorded weekly. Results showed that feed intake and body weight gain was improved only for the pigs fed diet with 1% of glutamine and raised in 25℃ chamber. Both ambient temperature and glutamine addition would have an impact of $HCO3^-$, $Na^+$, $Ca^{++}$, $pCO_2$, Beecf, Hct, THb, BUN, and creatinine on blood metabolites, but no effect on TP, $K^+$, $TCO_2$, pH, $pO_2$, BE, and IgG of concentrations . Therefore, to figure out the previous results suggested that under 25 ℃ condition to ingest 1% glutamine diet had a significant improvement of body weight gain and feed intake of growing pigs as well as only partial blood metabolites would be influenced by ambient temperature and glutamine.

(*F. C. Liu and C. B. Hsu*)

## The utilization of agricultural byproducts in KHAPS black pigs

The research was conducted to evaluate the growth performance and carcass traits of KHAPS black pigs by supplementing agricultural by-products (distillers' grain of barley, sweet potato vines, and water spinach) and pasture (napiergrass) to the feed. Thirty-six finishing pigs (18 female and 18 castrated) weighted nearly 80 kg (six months of age) were randomly allotted to three dietary treatments, including Treatment 1: feeding basal finishing diet for 50 days; the formula of Treatment 2 and 3 were the same, which supplemented 30% agricultural by-products and pasture (wet weight) to replace 20% basal diet according the recommended daily feeding quantity. The feed were mixed with water by 1:1, and pigs of Treatment 2 and 3 were fed for 50 and 64 days, respectively. The feed cost of the supplemented diet was 11.0 NT$/kg that was reduced 22% compared with the control diet. The results showed that the average initial body weight (BW) was 81.5 kg, and the BW on 50th day were 113.1, 99.9, and 102.1 kg, respectively, the BW and average daily gain (ADG) of control treatment were higher than the supplemented treatments ($P < 0.05$). In the carcass traits, the supplemented treatment tended to improve carcass performance, such as increasing dressing percentage, lean percentage and loin eye area, and decreased backfat thickness. Treatment 2 had the highest meat color score and Treatment 3 had the

highest marbling score (probably result from the longer feeding period). The regimen of supplementing agricultural by-products and pasture to the feed could be helpful to improve the carcass traits of finishing KHAPS black pigs.
(*C. B. Hsu, H. J. Huang and C. H. Wang*)

## The dietary application of γ-PGA and CMS in the KHAPS black pigs

The γ-PGA with the characteristics of chelating metal is a safe and stable biological material in the fermentation industry, and the condensed molasses soluble (CMS) from the fermentative by-product with low price contains diverse nutrients. The research was conducted to evaluate the applicability of γ-PGA and CMS applied to KHAPS black pigs. In Trial 1, Seventy-two starter pigs (initial BW 13.9 kg) were randomly allotted to three dietary treatments: Treatment 1 (basal starter diet) based on corn-soybean meal; Treatment 2 and 3 were basal diet supplemented 0.1% and 0.2% powdered γ-PGA, respectively. Pigs were fed *ad libitum* for 24 days. Results showed that average daily gain (0.50, 0.49, and 0.51 kg/d) and Gain/Feed ratio (0.49, 0.48, and 0.49) were not different among treatments. In trial 2, Forty-two growing pigs (initial BW 46.2 kg) were allotted to three dietary treatments: Treatment 1 was basal growing diet; Treatment 2 and 3 were the basal diet supplemented 0.1% γ-PGA and 3% CMS, respectively. Pigs were fed *ad libitum* for 22 days. It showed the growth performance were not different significantly, but the ADG (0.57, 0.55, and 0.63 kg/d) and G/F ratio (0.37, 0.36, and 0.39) in Treatment 3 tended to be improved. The results indicated that dietary 3% CMS supplementation tended to increase the growth performance of growing KHAPS black pigs.
(*C. B. Hsu, H. J. Huang and C. H. Wang*)

## Investigation of recombinant myostatin propeptide on growth performance and carcass trait of TLRI black pig

The objective of this study is going to evaluate the effect of the myostatin propeptide (mstn-prop) either hydrolyzed by pepsin or not on growth performance and carcass quality and carcass components during the later fattening period of TLRI black pig. Experimental animals adopt 18 hd body weight about 80kg of TLRI black pig inclusion of 9 hd castrated males and 9hd female, and they are raised on individual pen. Treatmental diets have control diet (0 ppm mstn-prop), adding 10ppm entire mstn-prop and adding 10 ppm hydrolyzed mstn-prop. The whole feeding period got starting from experimental pigs body weight 80 to 110 kg, and animals would weigh and record their feed ingestion amounts biweekly, and drawing blood samples to analyze blood traits, and while body weight up to 110 kg animals would be slaughter to measure carcass quality and carcass components. After that we would be subject to the previous results to identify effects of adding entire or hydrolyzed mstn-prop on growth performance and carcass quality and carcass components for the later fattening period of TLRI black pig. The results showed that the gilts of later fattening phase of TLRI black pigs reared with contained 10ppm of without hydrolyzing or hyrdolyzed by pepsin of mstn-prop had a higher daily gain than barrows. In the carcass traits, gilts of later fattening phase of TLRI black pigs fed with 10ppm without hydrolyzing or hydrolyzed by pepsin of mstn-prop cloud improve lean percentage and reduced depth of back fat and fat percentage, but in the barrows no effects. The blood trait of experimental pigs were not significantly changed by fed with contained 10 ppm of mstn-prop without hydrolyzing or hydrolyzed by pepsin.
(*F. C. Liu and Y. C. Lin*)

## Effect of Napiergrass Taishigrass No.3 and Napiergrass Taishigrass No.2 in diets on the Lactating Performance of Goats

Forage composition related to its nutritional value. The experiment was to asses the quality of Napiergrass Taishigrass strains (No.3 and No.2) as roughage component for lactating goats. A total of thirty-two Nubian lactating goats were selected in early lactation with an average body weight of 48 Kg, and producing average 2.55 Kg of milk daily. The goats were divided into two groups by average milk

production and body weight and assigned to two different mixed rations. The diets were formulated to fix Napiergrass Taishigrass strains (No.3 and No.2) at 33% of total mixed ratio on dry matter basis. After a 1 week adaptation, the feeding period lasted for 60 days. The results indicated that the daily dry matter intake of feed, milk yield, 4% fat-corrected milk and dry matter intake/body weight for the goats fed Napiergrass Taishigrass No.3 strains diet were significantly higher than those fed the Napiergrass Taishigrass No.2 strains diet ($P < 0.05$). The milk composition (milk fat, milk protein, lactose and total solid), for the goats fed Napiergrass Taishigrass No.3 strains diet was significantly higher than those fed the Napiergrass Taishigrass No.2 strains diet ($P < 0.05$). During the experimental period, non fat solids and somatic cell count had no difference between the treatments groups. There was no difference on the body weight and chest circumference change ratio. Nevertheless, bodyweight was heavier in goat fed diet included the Taishigrass No.3 strains et than the Taishigrass No.2 strains diet.

(*H. J. Huang, Y. K. Cheng, C. B. Hsu and C. H. Wang*)

## The utilization of the crossbred meat goat

The purpose of this study was to evaluate the reproductive performances of dams and the growth performances of their kids among the inbreeded, upgraded and three ways crossbred systems. The result showed that the kidding rate was highest in the groups of inbreeded and three ways crossbred systems. Meanwhile, the percentage of twin litters size and twin litters size plus triplet litters size were 88%and 94% in three ways crossbred group, which was the highest performance among three breeding systems. The body weight and body shaped of kids on inbreed group at birth were poorest than those of in another two groups ($P < 0.05$). The kids in three ways crossbred system had best performance of the body weight and body shaped at 3th and 6th months. However, there were no significant differences among these three groups. According to the results of the regression, which calculation from the body weight, body height, body length and chest girth of kids, it seemed that the R2 value was higher (0.93~0.97) between the weight and chest girth. This formula could be used for estimating the body weight of the kids.

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

The kids of the inbreeded (JA x JA), upgraded (JA x NU) and three ways crossbred (JA x BO) systems.

## Feasibility study of organic *Leucaena leucocephala* on the organic production system of Taiwan Black Goat

The aim of this study was to investigate feasibility of organic *Leucaena leucocephala (LL)*, the mixture of leaves, flowers, and pods on the organic production system of Taiwan Black Goat. Chemical analysis revealed that each kg the mixture contained 330 g dry matter (DM), 212 g crude protein, 39.9 g ether extract, 203.9 g crude fiber, and 71.4 g ash. Six growing does were used to determine the apparent digestibility of *LL* and twelve wethers were used for the feeding trial. In the digestibility trial, mean values of digestible organic matter, digestible crude protein, digestible ether extract, digestible fiber, and digestible nitrogen free extract in *LL* were 982.4, 196.5, 36.5, 197.1, and 436.8 g/kg DM, respectively. The feeding trial lasted 216 days. Each goat in organic group consumed 309 g/kg DM of *LL* daily during the experiment period. The final body weight, average daily weight gain, and feed conversion rate of goats in organic group were significantly lower ($P < 0.05$) than those in the control group. Meanwhile, the feed cost of per kg live body

weight gain was higher in goats in the organic group than that in the control group (NT$ 153.6 vs. 98.2/kg). Serum albumin and alanine aminotransferase (ALT) were higher in the organic group than that in the control group ($P < 0.05$). However, no significant difference was found on serum urea nitrogen, 3-3-5- triiodothyronine, or thyroxine between the two groups. No hair loss, dermatomycosis, or hydrostomia was found in the organic group during the period of survey. These results suggested that *LL* could be used as a feedstuff to native black goats in a cheaper organic goat production system in Taiwan. Nevertheless, the activity of serum ALT could rise to a high level while the goats were fed with the *LL* forage for a longer period.

*(S. D. Wang, A. K. Su and S. S. Yang)*

Feeding *Leucaena leucocephala (LL)* to the Taiwan Black castrated bucks

## Feeding value of whole rice plant silage on dairy goats

Rice is the major grain crops for human consumption in Asia and farmers are master in the cultivation technology. To explore the diverse feed resources to deal with the food security issue, whole rice plant becomes an option. The aim of this study was to evaluate the feeding value of the whole rice plant fed to dairy goats. A total of 18 head of Alpine and Sanna lactating goats with average daily milk yield above 2 kg were raised in individual pens in two repeated 28-d feeding trials. Whole rice plant (TK2) was harvested at milk stage, cut and to ensiled in 20-kg pails. Goats in control group were offered a diet with corn silage (20 % of dietary dry matter) and pangolagrass hay (10 %) as forage sources. In treatment group one, the pangolagrass hay was totally substituted by the whole rice plant silage; in treatment group two, half of the corn silage was substituted by the whole rice plant silage. Crude protein and neutral detergent fiber content of the whole plant rice silage were 5.45 % and 68.56 % (DM basis), respectively. Results showed that dairy goats fed on three kinds of forage perform the similar feed intake, milk yield (averaged 2.54 kg/day/goat), body weight change and concentrations of milk components (averaged milk fat of 3.34 %). The whole rice plant silage is a good forage source for lactating dairy goats.

*(G. J. Fan, J. C. Lo, J. B. Lin, T. F. Shiao and C. F. Lee)*

Paddy rice

Whole rice plant silage

## Effect of diets containing palm kernel oil meal on the lactation performance of dairy goats

To explore the diverse feedstuff for livestock, it was aimed in this study to evaluate the proper addition level of imported palm kernel oil meal (PKM) for dairy goat. Twenty head of Saanen and Alpine lactating goats with daily milk yield above 2 kg were raised individually in two repeated 28-d feeding trials. By substituting some of the pangolagrass hay, corn and soybean meal from the diet, PKM was added at

0%, low, medium or high level (21% of the diet DM). Nutrient supply for all four treatments was adjusted similar. Results indicated that the main effect of PKM addition was reflected on the milk fat trait. Diets with low and medium level of PKM stimulated milk fat percentage by 8%, 3.78% vs. 3.50% ($P < 0.06$) and tended to increase 16% of the 3.5% fat-corrected milk yield, 2.95 kg vs. 2.54 kg ($P < 0.11$) when compared to the control group. Panel test result showed that milk secreted from goats fed medium level of PKM had the higher acceptance and integrated impression ($P < 0.10$). Based on the bought price, NT$ 8 per kg of PKM, income over feed cost of three PKM added groups were higher than that of the control group by 16%, that is NT$ 8.6 increase per day per goat. It is suggested that diet included medium level of PKM for lactating goats in Taiwan is suitable and feasible.
*(G. J. Fan, T. F. Shiao and C. F. Lee)*

## Effects of diets containing palm kernel oil meal on the weight gain and ruminal digestion of dairy goats

The aim of this study was to evaluate the effect of palm kernel oil meal (PKM) added into diets at different proportions on body weight gain and ruminal digestion of dairy goat. A total of 40 head of Saanen and Alpine growing goats (24 castrated ram and 16 theave) with body weight averaged 35 kg were evenly assigned into 5 pens each group and run a 12-wk feeding trial. Ruminal digestion trial was conducted by four rumen-cannulated dry goats in a 4 x 4 latin square design with 14 days a period. At the last 48 hrs each period, rumen content samples were taken every one to three hrs. By substituting partially the pangolagrass hay, corn and soybean meal, PKM was added into diets at 0%, low, medium or high level (30% of diet DM). Nutrient supply for all four treatments was adjusted similar. Same diet manipulation was applied in digestion trial but with the lower substituting level (0 - 21%). The crude protein, neutral detergent fiber and crude fat content of PKM were 17.29%, 73.90% and 9.62% (DM basis). Results from feeding trial showed that goats fed diet from 0% to high level of PKM have the similar growth rate, 177, 173, 180 and 165 g, respectively. Rumen pH was also not influenced by the PKM addition, but diet containing high level of PKM significantly reduced the total rumen volatile fatty acid production. It was suggested that for growing castrated and female goats a diet with low to medium level of PKM could achieve good growth performance.
*(G. J. Fan, J. C. Chen, D. W. Yang, T. F. Shiao and C. F. Lee)*

PKM feeding trial

## Evaluation of surplus banana silage as feed source fed to Holstein lactating cows

Surplus banana silage (BS) was prepared for this experiment to determine its appropriate proportion in the diet for Holstein lactating cows. Forty-eight cows with average milk yield of 28.8 kg were randomly divided into four groups to procceed two repeated feeding trials, 21 days for each trial. BS was added into TMR at 0, 5, 10 or 15 kg (as fed basis) respectively, that is 0, 6.1, 11.9 and 17.4% of diet dry matter. The pH value, dry matter, crude protein, NDF and non-fiber carbohydrate of BS were 4.14, 28.2%, 5.4%, 11.4% and 78.1% respectively (DM basis). Results indicated that body weight change, dry matter intake (averaged 21.7 kg/cow/day), milk production (averaged 26.9 kg/cow/day) and yield of milk components were not affected by BS addition. However, cows fed 15 kg/day of BS had the lower milk fat percentage comparing with cows of 0 kg group (3.95% vs. 4.42%, $P < 0.05$); similar trend appeared in milk total solids ($P < 0.10$). It was recommended that addition of 10 to 15 kg of BS a day in the diet for Holstein lactating cows is appropriate.
*(C. F. Lee, J. C. Chen, D. W. Yang, G. J. Fan, T. F. Shiao and C. H. Hsieh)*

Banana ensiling

Banana silage

## Effects of feeding new napiergrass strain cv.TLG3 on lactating performance of dairy goats

Napiergrass (*Pennisetum purpureum*) is one of the widely used forages for ruminant in Taiwan. The aim of this study was to evaluate the feeding value of the new strain of napiergrass cv. TLG3 characterized with high leaf to stem ratio. Four napiergrasses, cv.TLG2, cv.TLG3, #7728 and #8810, were ensiled in 20-kg pails respectively. A total of 20 head of Saanen and Alpine goats were randomly assigned into four treatments and individually fed in a 28-d feeding trial. Except for the napiergrass origin, the other diet compositions were all the same for four goat groups. Napiergrass silage constituted of 30% of the diet dry matter. Result from feeding trial showed that cv.TLG3 diet could stimulate the higher dry matter intake of goats than those fed #8810 diet ($P < 0.05$). Goats fed cv.TLG3 diet produced more milk than goats fed cv.TLG2 diet or #8810 diet ($P < 0.05$). Goats fed cv.TLG2 diet had the higher milk protein percentage than goats fed #7728 diet or #8810 diet ($P < 0.05$). Napiergrass strains did not affect the daily body weight gain, percentages of milk fat, milk lactose and milk total solid ($P > 0.05$). Feeding of cv.TLG3 napiergrass could help goats to achieve the better lactating performance than the cv.TLG2 strain. Cv.TLG3 is a good forage source for lactating dairy goats with high feeding value.

*(G. J. Fan, T. R. Li, J. B. Lin, Y. K. Cheng, T. F. Shiao and C. F. Lee)*

## Feeding value of the ensiled surplus orange for Holstein heifers

In order to seek a method to properly cope with the surplus produces and extent their utility, formulated orange silage was applied to feed growing Holstein heifers. Fresh orange 3,000 kg mixed with 210 kg wheat bran and 210 kg cut Pangolagrass hay were filled evenly into the sausage silage bag to make orange silage. A total of 36 heifers of 18 months of age and 450 kg of body weight were randomly divided in three groups; they were 0 kg orange silage + 10 kg corn stem silage, 3 kg orange silage + 6 kg corn stem silage and 6 kg orange silage + 2 kg corn stem silage. The orange silage provided 0, 9 or 19% of dietary dry matter, respectively in three groups. Heifers were fed with totally mixed ratio once every morning ad libitum. Feed Intake was recorded everyday. Feeding trial consisted of 14 days of adapting period and 46 days of experimental period. Results showed the daily dry matter intake, 8.3, 8.9 and 8.7 kg, and average daily gain, 0.95, 0.88 and 0.95 kg, were all similar among groups ($P > 0.05$). Abnormal health conditions were not found in all groups. It was suggested this formulated orange silage could be used as a good feed source for Holstein heifers, which was feasible to cope with surplus produces.

*(J. C. Chen, C. H. Yang, G. J. Fan, D. W. Yang, J. B. Lin, T. F. Shiao, C. H. Hsieh and C. F. Lee)*

Orange ensiling

Orange silage

## Evaluation of feeding model of organic native chicekn breederm

Twenty day-old LRI two-way cross native chicken males Taishu No. 11 and 100 females Taishu No. 12 were used as experimental animals and allotted into 2 groups. The organic diets for growing and reproduction period mainly contained organic rice and organic soybean. The nutrient contents were similar with the control group. The control group was fed common diets. Water and feed were provided ad libitum. Feeding environment and feeding density for both groups followed the regulation of the organic feeding standard. Growth performance was measured every 4 weeks. Reproduction period began at 20 weeks of age. Egg production, fertility rate and hatch ate were recorded. The results in growing period indicated that average males' body weight of control group at 4, 8 weeks of age was significantly higher than the organic group ($P < 0.05$). No significant difference was found in the females. Average males' weight gain of control group during 0-4 weeks of age was significantly higher than that of the organic group ($P < 0.05$). Average males' weight gain of organic group during 8-12 weeks of age was significantly higher than that of the control group ($P < 0.05$). No significant difference was found at the other weeks of age for both males and females. The results in reproduction period indicated that hen-day egg production rate of the organic group was higher than that of the control group before peak egg production period. During peak egg production period, the control group was higher than the organic group. No significant difference was found on fertility and hatch rate at 27 weeks of age. At 31 weeks of age, fertility and hatch rate of the control group was significant higher than that of the organic group ($P < 0.05$). The results can be provided for the reference of organic feeding farms.

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

## Research on energy and protein requirement of small type silky chicken during 9-16 weeks of age

Three hundred and sixty day-old LRI silky chickens were allocated into 6 treatment groups. Each group had three replicates in three pens. Each pen had 20 birds. Corn-soybean basal diets were formulated to have 15, 17, 19% CP and 2,800, 3,000 kcal/kg ME in 3×2 factorial design. Water and feeds were supplied ad libitum. Growth performance was measured at 8, 12 and 16 weeks of age. Blood was collected for biochemical analysis at 16 weeks of age. The results indicated that birds fed with CP 17% and 2,800 or 3,000 kcal/kg ME had significantly higher average body weight than birds fed with CP15%、ME 2,800 kcal/kg at 12 and 16 weeks of age ($P < 0.05$). Birds fed with CP 17%、ME 3,000 kcal/kg had the highest and CP15%、ME 2,800 kcal/kg had the lowest weight gain during 9-12 weeks of age ($P < 0.05$). Birds fed with CP 15%、ME 3,000 kcal/kg had the highest and CP15%、ME 2,800 kcal/kg had the lowest weight gain during 13-16 weeks of age ($P < 0.05$). Feed efficiency was the best at CP 19%、ME 3000 kcal/kg (3.66) and the worst at CP 15%、ME 2800 kcal/kg (4.54) during 9-12 weeks of age. No significant difference was found during 13-16 weeks of age (5.30-6.06). Birds fed with CP19%、ME 3,000 kcal/kg had the highest BUN and TG and birds fed with CP 17%、ME 3000 kcal/kg had the highest uric acid. The results recommended that protein and energy requirement of silky chicken during 9-16 weeks of age was respectively 17% and 3,000 kcal/kg.

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

## Comparison of cholesterol and fatty acids contents of leghorn chicken, native chicken and silky chicken

The experiment was to compare the cholesterol and fatty acids contents of Leghorn chicken, native chicken and silky chicken raised in Taiwan Livestock Research Institute. Six eggs were randomly selected from Leghorn chickens, LRI native chickens and silky chickens, respectively at 40 weeks of age. Egg albumens and yolks were separated and the yolks were frozen for further determination. The yolk's cholesterol and fatty acid contents were determined using AOAC method and gas chromatography,

respectively. The results indicated that native chicken eggs had the highest cholesterol content and Leghorn chicken had the lowest ($P < 0.05$). Linoleic acid and α-linolenic acids were found highest in Leghorn chicken and lowest in silky chicken ($P < 0.05$). DPA and DHA were found highest in native chicken and lowest in Leghorn chicken ($P < 0.05$). No significant difference was found in AA. Different breeds have different egg nutrient contents. The results can supply for the reference of egg nutrients.
(*Y. F. Lin, H. L. Liu, C. M. Hung and C. H. Hsieh*)

## Effects of tetracycline-withdrawal periods on the drug residues in silky chicken

The purpose of this study was to investigate the effects of tetracycline-withdrawal period on the drug residues in Silky chicken. One hundred and twenty Silky chickens at 12 weeks-old were randomly assigned to 3 groups with 40 chickens for each. Chickens were fed one of three diets: (1) basal diets as control diet; (2) control diet added 125 ppm chlortetracycline (CTC); (3) control added 125 ppm oxytetracycline (OTC). The antibiotics contents of blood, meat, liver and excreta of Silky chicken were measured during the drug-withdrawal period from 1 to 43 days. The results showed that the drug used in chickens had significantly linear effects (R2 = 0.54 - 0.56) and quadratic effects ($R^2$ = 0.47 - 0.86) among the CTC residues in blood and meat. The OTC resides in blood and meat had significant linear effects (R2 = 0.43 - 0.64) and quadratic effects ($R^2$ = 0.49 - 0.86), but had a lower positive correlation in excreta. Moreover, there were highest correlation coefficient (r = 0.89 - 0.98, $P < 0.001$) between the drug in meat and blood of chickens. There had a high correlation coefficient (r = 0.94 - 0.85) between the drug in meat and liver. Nevertheless, a low correlation coefficient (r = 0.82 - 0.86) between the drug in meat and excreta of chickens was observed. In conclusion, the antibiotics residual in blood of chickens detected by LC/MS/MS can be applied as a technique for monitoring antibiotics residue in Silky chickens. The monitoring period should be more than two weeks for CTC residues, but no less than four weeks was required for monitoring OTC residues.
(*B. L. Shih, R. D. Wang and M. L. Lee*)

## Effects of different dietary levels of copper and zinc on the laying performance and egg shell quality in leghorn layers

This experiment was conducted to study the effects of different dietary levels of copper and zinc on the laying performances and egg shell quality for Leghorn layers. A total of one hundred and eighty Leghorn layers were need for experiment, these hens were allocated into six groups at 25 and 37 weeks of age, respectively. Experiment was 2 × 3 factorial design including two dietary Cu levels, 9 and 18 mg Cu/kg by adding CuSO4 and three zinc levels 60, 90 and 120 mg Zn/kg by adding ZnSO4. Each trials last for 4 weeks, respectively. The laying performance and egg shell quality were measured during the experimental period. This result indicated that the dietary 60 mg Zn/kg had a low tendency of egg production, egg mass and poor feed conversion rate, but those did not significantly differences on dietary Cu and Zn levels. Hens fed with 60 mg Zn/kg diet significantly ($P < 0.05$) reduced shell/egg weight percentage and shell thickness. Dietary Zn levels as 60 mg/kg decreased ($P < 0.05$) the calcium and phosphorus concentrations. There was significant interaction between dietary Cu and Zn levels. These results indicated that dietary Cu 9 mg/kg and Zn 90 mg/kg were require be provided for the good laying performance and egg shell quality of Leghorn layers.
(*B. L. Shih and M. L. Lee*)

## Effects of different dietary levels of copper and zinc on the metabolic retention of copper and zinc in leghorn layers

This experiment was conducted to study the effects of different dietary levels of copper and zinc on the metabolic retention of copper and zinc for Leghorn layers. A total of sixty Leghorn layers, at 28 weeks of age, were allocated into six groups. Experiment was 2 × 3 factorial including two dietary Cu levels, 9 and 18 mg Cu/kg by adding $Cu_2SO_4$ and three zinc levels 60, 90 and 120 mg Zn/kg by adding

ZnSO4. In the metabolic trial last for 7 days, each layer fed with 80 g of feed per day during the experimental period. The excreta were collected by adding chromium oxide (Cr2O3) for "marker to marker" method. The feed and excreta were measured for the metabolic retention of copper and zinc. This result indicated that the weight of excreta (dry matter) did not affect by these diet treatments. The hens fed with Cu 18 mg/kg had significantly higher ($P < 0.05$) copper concentration and contents. The significant higher ($P < 0.05$) zinc concentrations were observed when hens fed the Cu 18 mg/kg and Zn 120 mg/kg. The contents of zinc significantly increased ($P < 0.05$) when dietary zinc level was increased. There were significantly ($P < 0.05$) lower linear retention of copper and zinc when dietary copper and zinc were increased. These results indicated that the concentration of copper and zinc in excreta can fit in the national copper and zinc limit when the hens fed the Cu 9 mg/kg and Zn 90 mg/kg or lower in diet.
(*B. L. Shih and M. L. Lee*)

## Effects of different dietary levels of distiller's dried grains with solubles on the egg shell quality and yolk color in layers

This experiment was conducted to study the effects different dietary levels of Distiller's Dried Grains with Solubles (DDGS) on the egg characteristics, egg shell quality and yolk color for layer. A total of two hundred and forty Leghorn layers at 23 weeks of age were randomly assigned to 4 groups. Each group of hens had three replicates with 20 layers. The hens were fed the diets containing 0, 6, 12 and 18% DDGS, respectively. All experimental diets contained ME 2900 kcal/kg and CP 15%. Feed and water were supplied *ad libitum*. The egg characteristics, egg shell quality and yolk color were measured during the experimental period (23-42 weeks of age). The results indicated that dietary DDGS levels did not affect egg weight and egg specific gravity. The hens fed with 18% DDGS diet had significantly ($P < 0.05$) lower egg white height and Haugh unit when compared with 6% DDGS diet. Moreover, there lower percentage of yolk weight for the control treatment. Hens fed the DDGS supplemented diets had significantly ($P < 0.05$) higher percentage of egg shell weight, thickness and breaking strength. Otherwise, the brightness (L value) and red chromaticity (a value) of yolk were significantly higher ($P < 0.05$) then hens supplemented with DDGS diets. High yellow chromaticity (b value) of yolk was found in the hens fed the 12% DDGS than the control. In conclusion, the dietary DDGS levels below than 12% or 12% did not affect the egg quality, and can improve the egg shell quality, color and brightness of yolk in laying hens.
(*B. L. Shih, S. M. Liou, M. L. Lee and Y. K. Chen*)

## Effects of different dietary levels of distiller's dried grains with solubles on the laying performance and blood characteristics in layers

This experiment was conducted to study the effects of different dietary levels of Distiller's Dried Grains with Solubles (DDGS) on the laying performance and blood characteristics of layer during the laying period. A total of two hundred and forty Leghorn layers at 23 weeks of age were randomly assigned to 4 groups. Each group of hens had three replicates with 20 layers. The hens fed the diets containing 0, 6, 12 and 18% DDGS, respectively. All experimental diets contained ME 2900 kcal/kg and CP 15%. Feed and water were supplied ad libitum. The feed intake, laying performance and blood characteristics of layer were measured during the experimental period (23-42 weeks of age). The results indicated that hens fed 18% DDGS had significantly lower ($P < 0.05$) feed intake, hen-day production and egg mass compared with the other treatments. Moreover, the feed conversion ratio become poor with the increase DDGS levels although of experimental period. The weight gain of hens fed the 18% DDGS was lowest no significant was observed. The weight gain, total protein and uric acid contents in blood were not affected by those treatments. The plasma calcium and phosphorus were significantly higher ($P < 0.05$) for hens fed the diet with 6 and 12%, 12% DDGS, respectively. The high cholesterol content was found in the hens fed the diet with 12% and 18% DDGS treatments. In conclusion, the diet with 12% and lower DDGS were not affected the laying performance, afterward were increased the calcium and phosphorus contents of blood in laying hens.
(*B. L. Shih, S. M. Liou, M. L. Lee and Y. K. Chen*)

## Effect of raring system on growth performance, carcass traits and sensory evaluation for Taiwan game hen

This study was conducted to investigate the effect of three raring systems as cage, floor and free-range on growth performance and carcass traits for Taiwan game hens. Four hundred and eighty birds at eight weeks old age were randomly divided into three raring system groups as one hundred and sixty birds for each cage, floor and free range group. Follow the bird growth period, we changed the feed every four weeks but the same feed in ad libitum for each groups. We recorded the feed intake and mortality every weeks and weight every four weeks until birds at twenty weeks old age. Then we chose ten birds from each group for evaluating carcass traits, meat components and sensory evaluation. The result showed that raring system did not influence the performance of Taiwan game hen on feed intake, feed efficiency, dressing percentage, breast meat percentage, moisture, protein, fat, collagen, ash content, and cooking loss percentage of breast meat, and thawing loss percentage of breast and thigh meat. However, the birds in cage group had better mortality performance but lower protein and collagen content of thigh meat than that of in the other two groups ($P < 0.05$). Meanwhile, the birds in free-range group had lighter twenty weeks old age weight; lower thigh part ratio, abdominal fat ratio, and fat content of thigh meat; higher value on the firmness and toughness test of breast and thigh meat; better performance on shank color and sensory evaluation on flavor, chewing, juicy and total acceptance value of breast and thigh meat. Above all, free-range raring system for Taiwan game hen not only won't lost feed efficiency but can improve its meat sensory evaluation and is worth to promotion to farmers.

(*I. H. Chang, H. Y. Kuo, C. Y. Lin and A. K. Su*)

Taiwan game hen at twenty week old age at free-range raring system

## Effect of metabolizable energy level on egg production and egg quality traits for brown egg shell laying hens during early egg production period

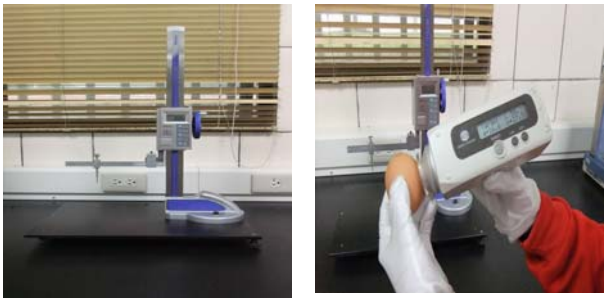
This study was conducted to investigate the effect of metabolizable energy levels on egg production and egg quality traits for brown egg shell laying hens which were feed in cage system during non feather-change and egg production phase I as early egg production period. One hundred and twenty ISA commercial brown shell layers at twenty-five-week-old were randomly divided into four groups which were feed isoprotein level (16.8%) but different ME level diet with 2409 kcal/ kg, 2481 kcal/ kg, 2554 kcal/ kg and 2627 kcal / kg, respectively. Equivalent to have daily metabolizable energy intake for 265 kcal, 273 kcal, 281 kcal, and 289 kcal for these four groups birds, respectively. We were offered restricted diet for 110g per bird per day, in order to make sure every bird can consume all nutrition that we design to offer. We recorded the egg production traits and egg quality traits after five weeks experiment when birds at twenty-nine-week-old. The results showed that metabolizable energy intake levels did not influence the performance of laying hens on body weight, mortality, egg shell quality, Haugh unit, yolk index, egg shape index, egg yolk and egg white ratio, egg shell and egg yolk color value. However, birds in 265 kcal low ME level group had lower egg weight and yolk weight than those in the other groups ($P < 0.05$). Meanwhile, birds in 273 kcal middle ME level group had better performance in egg mass and egg efficiency ($P < 0.05$). Above all, brown egg laying hens consume 273 kcal daily metabolizable energy level feed was sufficient to maintain normal egg production performance and egg quality in cage system during early egg production period.

*(I. H. Chang, H. Y. Kuo, J. F. Huang, C. Y. Lin and A. K. Su*)

## Effect of protein consumption on egg production and egg quality traits for brown egg shell laying hens during early egg production period

This study was conducted to investigate the effect of protein consumption on egg production and egg quality traits for brown egg shell laying hens which were feed in cage system during non feather-change and egg production phase I as early egg production period with 87.8% average egg production before experiment. Eighty ISA commercial brown shell laying hens at thirty one week old age were randomly divided into four groups which were feed isoenergy level (2,752 kcal /kg) and isocalcium (3.92%) level but different protein level diet with 14.82%, 16.25%, 17.75% and 19.14%, respectively. Equivalent to have daily protein consumption with 15.5 g, 17.0 g, 18.5 g and 20.0 g for these four groups birds, respectively. We were offered restricted diet for 105 g per bird per day, in order to make sure every bird can consume all nutrition that we design to offer. We recorded the egg production traits and egg quality traits after five weeks experiment when birds at thirty five week old age. The results showed that protein consumption levels did not influence the performance of laying hens on egg production, egg efficiency, egg shell strength, egg shell color, Haugh unit, yolk ratio albumin ratio, and egg sharp index. However, birds in 20.0 g high protein level group had higher egg weight and egg mass than that of in the other three groups ($P < 0.05$). Generally, it was suggested that the best daily protein intake volume was 20.0 g per day per hen. This dosage can induce a better egg mass performance for brown egg laying hens in cage system during early egg production period.

(*H. Y. Kuo, I. H. Chang, C. Y. Lin and A. K. Su*)



Record egg yolk height to evaluate egg quality at the end of the experiment

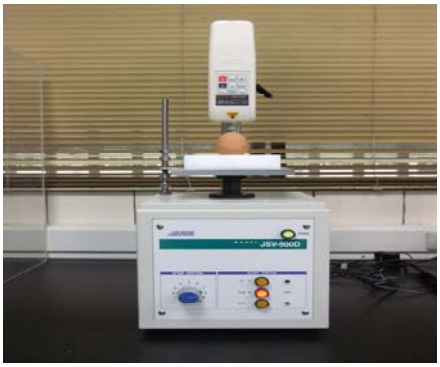
## Effect of calcium consumption on egg production and egg shell quality traits for brown egg shell laying hens during early egg production period

This study was conducted to investigate the effect of calcium consumption on egg production and egg shell quality traits for brown egg shell laying hens which were feed in cage system during non feather-change and egg production phase I as early egg production period with 93% average egg production before experiment. Eighty ISA commercial brown shell laying hens at forty one week old age were randomly divided into four groups which were feed isoenergy level (2,818 kcal/ kg) and isoprotein level (15.4%) but different Ca level diet with 3.18%, 3.67%, 3.93% and 4.06%, respectively. Equivalent to have daily Ca consumption with 3.3 g, 3.5 g, 3.7 g and 3.9 g for these four groups birds, respectively. We were offered restricted diet for 105g per bird per day, in order to make sure every bird can consume all nutrition that we design to offer. We recorded the egg production traits and egg shell quality traits after six weeks experiment when birds at forty seven week old age. The results showed that Ca consumption did not influence the performance of laying hens on egg mass, egg efficiency, egg shell strength, egg shell thickness, and egg shell ratio. However birds in 3.9 g high Ca consumption group had lower calcium content in shell, calcium shell / calcium consumption ratio, higher free calcium content and total calcium content in serum than that of in the other three groups ($P < 0.05$). Evidences showed that excessive calcium intake does not improve egg shell quality and only reduces the utilization of calcium. Generally, it was suggested that the best calcium intake volume was 3.3 g per day per hen. This dosage is enough to maintain the characteristics of egg production, egg quality and utilization of calcium for brown egg laying hens in cage system during early egg production period.

(*H. Y. Kuo, I. H. Chang, C. Y. Lin and A.K. Su*)

## Effect of calcium consumption on egg production and egg shell quality traits for brown egg shell laying hens during late egg production period

This study was conducted to investigate the effect of calcium consumption on egg production and egg shell quality traits for brown egg shell laying hens which were feed in cage system during non feather-change and egg production phase I as late egg production period with 62% average egg production before experiment. Eighty ISA commercial brown shell laying hens at eighty four week old age were randomly divided into four groups which were feed isoenergy level (2,818 kcal/ kg) and isoprotein level (15.4%) but different Ca level diet with 3.18%, 3.36%, 3.54% and 3.72%, respectively. Equivalent to have daily Ca consumption with 3.5 g, 3.7 g, 3.9 g and 4.1 g for these four groups birds, respectively. We were offered restricted diet for 110 g per bird per day, in order to make sure every bird can consume all nutrition that we design to offer. We recorded the egg production traits and egg shell quality traits after six weeks experiment when birds at ninety week old age. The results showed that Ca consumption did not influence the performance of laying hens on calcium and ash contents of egg shell and egg shell strength. However birds in 4.1 g high Ca consumption group had higher egg weight and serum total calcium content ($P < 0.05$). Meanwhile birds in 3.7 g middle Ca consumption group had higher egg production and egg mass ($P < 0.05$). Evidences showed that excessive calcium intake does not improve egg shell quality and only reduces the utilization of calcium. Generally, it was suggested that the best calcium intake volume was 3.7 g per hen per day. This dosage is enough to maintain the characteristics of egg production, egg quality and utilization of calcium for brown egg laying hens in cage system during late egg production period.
(*H. Y. Kuo, I. H. Chang, C. Y. Lin and A.K. Su*)



Record egg shell strength to evaluate eggshell quality at the end of the experiment

## The evaluation of both growth performance and feeding cost on both of White Roman and Hybrid Chinese geese

The major purpose of this study was to evaluate the growth performance and the feeding cost between White Roman (WR) and Hybrid Chinese geese (HC). The result indicated that the body weight (BW) of WR geese was significantly ($P < 0.05$) higher than HC geese at 4 weeks of age. In the experimental period, the BW of WR geese was higher than HC geese at same age. The feed conversion rate of WR geese was significantly ($P < 0.05$) better than HC geese, because the growth period of HC geese was longer than WR geese. The BW of HC geese on restriction group was lower than *ad libitum* group 0.32 kg/goose at 16 weeks of age. It means that the insufficient nutrition of the restriction geese was can not recovered by Napiergrass *ad libitum*. The feeding cost of BW gain on the WR, HC, restricted HC was 64, 76, 79 NT$/kg, respectively. The lowest feeding cost was WR. The feeding cost of the restricted HC geese was higher than HC geese. It means that the whole period restriction method can not decreased feeding cost.
(*Y. C. Chang,, C. M. Wang, C. C. Shiau, P. C. Nien, C. L. Hu and Y. S. Jea.*)

## The study on reasons of reduced pidan yield rate in summer season

The aim of this experiment was to measure traits of eggs laid by brown Tsaiya duck reared under different environmental temperatures. The ducks were divided into three treatment groups and reared in three artificial climate chambers; their respective ambient temperature and relative humidity were set at the average of the temperature and relative humidity from the four southern counties (Chiayi, Tainan, Kaohsiung, and Pintung) in January, April and July, 2011, respectively. The traits determined in this experiment included: eggshell pores, eggshell thickness, eggshell strength, egg weight, Haugh unit, egg-shaped index, the relative content of albumin protein, approximate composition of egg white, approximate composition of egg yolk, pidan yield rate, pH of pidan, pidan coagulation score color of pidan. The results showed that even ducks raised under the hot environment, the pidan yield rate could be improved via lowering the pickling environment temperature and extending the pickling duration.
(*C. H. Su, C. H. Cheng, J. H. Lin and J. F. Huang*)

Brown Tsaiya duck reared in the artificial climate chamber

## The effects of sun-cured peanut vine diet on the growth performance of domestic geese from 9 to 13 weeks of age

The purpose of this study was to evaluate the effects of sun-cured peanut vine on the growth performance of White Roman geese from 9 to 13 weeks of age. Total of 96 White Roman geese were randomly divided into A, B, C, and D groups which were fed by a, b, c, and d diets, respectively. The total crude protein (CP) of the four diets was same 15 %. The 15 % CP of the four diets were partially replaced with the sun-cured peanut vine 0.0, 0.5, 1.0, and 1.5 % CP, respectively. The concentration of the peanut vine in each diet was 0.00, 6.27, 12.55, and 18.82 %, respectively. The results showed that the feed intake was significantly increased by using sun-cured peanut vine ($p < 0.05$). The body weight (BW) gain was not increased by increasing feed intake, although using sun-cured peanut vine on the diets was not depressing the BW gain of geese. It implied that we need to consider the high crude fiber was an effect on feed intake of geese. In the carcass quality, both of the weight and percentage of abdominal fat (from 234 ± 63 to 185 ± 38 g, P= 0.1439 and from 4.14 ± 0.86 to 3.34 ± 0.19 %, P= 0.064, respectively) had decreased tendencies by increasing sun-cured peanut vines in diet. In contrast, both of the weight and percentage of gizzard (from 181±14 to 201 ± 14g, P= 0.059 and from 3.25 ± 0.37 to 3.65 ± 0.12 %, P=0.060, respectively) had increased tendencies by increasing peanut vines in diet. However sun-cured peanut vine was useful on the growth domestic geese, but the character of high fiber on peanut vine should be noted.
(*Wang, C. M., Y. C. Chang, C. L. Hu, P. C. Nien and Y. S. Jea*)

## Determination of polycyclic aromatic hydrocarbons and polychlorinated biphenyls in feeds

In this study, the combination of microwave extraction with normal phase column clean up were used to purify many feed ingredient. Besides, ultra performance liquid chromatography (UPLC) assisted with UV detector and fluorescence detector were used to detect the polychlorinated biphenyls (PCBs) and polycyclic aromatic hydrocarbons (PAHs) in pasture, fish meal, meat and bone meal and animal fat. The results showed that the instrumental detection limit (IDL) for 16 PAHs were 0.054~50.0 ppb, and 0.071~0.173ppm for 12 PCBs. After spiking PAHs standard solution in forage, fish meal, meat and bone meal, tallow, the recovery rate were 72.5~107.5%、69.58~102.97% 、70.1~98.4% and 71.2~95.0%,

respectively, and the coefficient of variation (CV) were 0.6~7.9%, 4.95~14.74%, 1.6~8.1%, 0.7~9.3%, respectively. With high recovery rate and reproducibility, the present PAHs and PCBs detection method, can be applied for the routine detection on these feed samples.

(*R. D. Wang, M. C. Teng and M. L. Lee*)

# Animal Physiology

## Improvement of cloning efficiency by somatic cell reprogramming

The low success rate of animal cloning by somatic cell nuclear transfer (SCNT) is believed to be associated with epigenetic errors including abnormal DNA hypermethylation. Reprogramming of a differentiated cell nucleus by somatic cell nuclear transplantation is an inefficient process. Following nuclear transfer, the donor nucleus often fails to express early embryonic genes and establish a normal embryonic pattern of chromatin modifications. These defects correlate with the low number of cloned embryos able to produce embryonic stem cells or develop into adult animals. Here, we show that the differentiation state of the donor cell influence the efficiency of genomic reprogramming. First, neural stem cells, when used as donors for nuclear transplantation, produce clone embryo at a higher efficiency than fiberblast donor cells, demonstrating a correlation between the state of differentiation and cloning efficiency. The result showed that the goat ear textile fiber metrocyte has after cell rallying displays pluripotent genes: oct-4, Nanog as well as PECAM-1, but will not have displayed after the cell rallying goat ear textile fiber metrocyte. Surpasses by stem cell extract rallying for the nuclear cell was affected by the mature ovum metrocyte extract. Has not carried on the duplication embryo production goat of ear textile fiber metrocyte after the stem cell extracted liquid processing to have the high cytomixis rate (90.5% & 72.1%), but is low its growth to the pouch embryo's ratio (23.1% & 17.9%), demonstrated that gene rallying processing in advance is helpful for the nuclear cell in the promotion duplication animal produces the system efficiency.

*(F. H. Chu)*

## Establishment of serum-free and feeder-free culture system of porcine embryonic stem cells (I) Establishment of serum-free in vitro culture system

The purpose of this study is to establish a stable serum-free in vitro culture system and to investigate the effects of serum-free, serum replacement and growth factors on the cell proliferation, efficiency of colony formation, maintenance of undifferentiation status, cytotoxicity, pluripotency, and apoptosis of porcine embryonic stem (pES) cells. The results shown that the growth curve, colony formation and undifferentiation status have no significant improvement in the culture systems supplement with bFGF and TGF-β1 growth factors. However, the LDH cytotoxicity has no difference which compared to the control. The pluripotency of pES cells shown positive staining by immunocytochemical analysis with Oct-4, AP, SSEA-3, SSEA-4, TRA-1-60, and TRA-1-81 pluripotent markers, and indicated they can maintain the pluripotency in the culture system supplements with bFGF and TGF-β1. There are also no apoptosis in 24, 36, and 48 hours after bFGF and TGF-β1 supplementation. Those results can provide as serum-free culture system for culturing porcine embryonic stem cells.

*(J. R. Yang)*

## Establishment of serum-free and feeder-free culture system of porcine embryonic stem cells (II) Establishment of feeder-free in vitro culture system

The purposes of this study were to establish a stable feeder-free in vitro culture system and to investigate the effects of laminin (20 mg/ml), collagen IV (10 mg/ml), fibronectin (5 mg/ml) and Matrigel® (1:20) on the cell proliferation, colony formation, undifferentiation status, pluripotency, and apoptosis of porcine embryonic stem cells. The results shown: (1) Growth curve: the growth curves in the feeder-free culture systems which containing 16% FBS, 16% FBS supplemented with STO conditional medium, and 16% FBS supplemented with bFGF 1 ng/ml were 0.17~0.26, 1.00~1.85 and 1.51~1.95, respectively. (2) Colony efficiency and maintain undifferentiation status: the ESM supplemented with 16% FBS could not maintain the undifferentiated status of pES colonies. The colony efficiency of ESM containing

16% FBS, supplemented with STO conditional medium or bFGF 1 ng/ml were 5.56~11.11% and 5.62~23.46%, respectively. (3) LDH toxicity: the LDH toxicity shown 1.45~1.48, 1.38~1.43, and 1.37~1.43 between the three different medium. (4) Pluripotency: the feeder-free culture system shown positive staining by ICC analysis with Oct-4, AP, SSEA-3, SSEA-4, TRA-1-60, and TRA-1-81 pluripotent markers, that indicated they could maintain the pluripotency of pES colonies. (5) Apoptosis analysis: there were no apoptosis when used laminin, collagen IV, fibronectin and Matrigel® as feeder-free culture system. Those results could provide as feeder-free culture system for culturing porcine embryonic stem cells. We hope that the stable feeder-free culture system can provide as an optimal system for culturing porcine embryonic stem cells.
*(J. R. Yang)*

## Establishment of goat dental stem cells

The aims of this project were to demonstrate and characterize populations of goat dental pulp stem cells (gDPSCs). The proliferation and differentiation potential of gDPSCs was investigated. The expression profiles of a total of 9 cell-surface antigen markers were compared. Fluorescence-activated cell sorting (FACS) analysis was performed to characterize the phenotype of gDPSCs. The gDPSCs、hDPSCs and hBMSC populations exhibited similar expression patterns for CD44, CD73, CD90, CD105 and CD166，The stem cell did not react with CD14, CD34, CD45 and CD150，gDPSCs was similarly expressed, albeit at low levels for CD44, CD73, CD90 and CD105.The proliferation rate of gDPSCs was assessed. The result demonstrates that gDPSCs had a high proliferation rate during early passages, but decreased gradually in culture. The colony-forming cell population, which gDPSCs had a high CFU-F with hDPSCs and hBMSC. Next, the differentiation of stem cell was determined. To investigate the potential of gDPSC to undergo osteoblastic differentiation, established gDPSC cultures were an ostogenic inductive medium to induce mineralization in vitro. Small round alizarin red-positive nodules formed in the gDPSC cultures after 3 weeks of induction, indicating calcium accumulation in vitro. After 3 weeks of culture with an adipogenic inductive medium, gDPSC developed into oil red O-positive lipid-laden fat cells. Adipogenesis was clearly confirmed by the formation of fat droplets in the cytoplasm. This development correlated with an upregulation in the expression of adipocyte specific transcripts, lipoprotein lipase and osteoblast specific transcripts, Osteonectin and Osteopontin as detected by RT-PCR. Cell populations were positive for the progenitor/stem cell marker Nanog, the osteoblast marker Osteonectin and Osteopontin.
*(C. C. Chang, H. H. Chang, L. R. Chen and S. Y. Wu )*

## Goat dental stem cell for tissue engineering

An essential aspect of tissue engineering is the identification of suitable scaffolding materials to support cell growth, differention and tissue regeneration. They have been addressed with hydroxyapatite, tricalcium phosphate, bovine bone, and collagen, among other things. However, as of yet, no scaffold and inductive microenvironment combination has been shown to contribute to the regeneration of complete dentin tissue, all these tooth-like structures do not mimic exact shape and size of a natural tooth.This study is an assessment of whether gTDM can provide a suitable scaffold and inductive microenvironment for regenerating complete dentin tissue. To test the supporting and inductive effects of treated goat dentin matrix (gTDM) on complete dentin regeneration, goat dental stem cells were seeded on to gTDM and further incubated for 1 -9 days in vitro. Taken together, these results suggest that, for dentin regeneration, gTDM is a suitable scaffold and inductive microenvironment. gTDM showed superior biocompatibility and bioactivity. These issues will be addressed in future investigations.
*(C. C. Chang, H. H. Chang, L. R. Chen and S. Y. Wu)*

## Establish the technology of goat semen vitrification and low dose insemination

The aim of this study was to establish the method of French straw goat semen vitrification. In the research 1 was to investigate the effect of different concentration of dimethyl sulfoxide (DMSO) (final concentration of

0 ~ 9%), ethylene glycol (EG) (final concentration 0 9%) and acetamide (final concentration 0-9%) respective combination with glycerol (final concentration 0-6%) on the motility, viability, acrosome integrity, DNA integrity and mitochondria potential of French straw vitrified-thawed Alpine goat semen. The results showed that 6% DMSO + 6% glycerol group on the motility (41.08 ± 2.13%), viability (55.48 ± 2.49%) and acrosome integrity (35.89 ± 3.02%) were significantly higher than other groups ($p < 0.05$); 6% EG + 6% glycerol group motility (41.38 ± 0.87%), viability (57.36 ± 0.66%), acrosome integrity (34.76 ± 0.51%) and DNA integrity (71.23 ± 1.04%) was significantly higher than other groups ($p < 0.05$); 3%Acetamide + 6% glycerol group of motility (40.78 ± 0.96%), vibility (61.54 ± 1.19%), acrosome integrity (31.50 ± 1.20%), DNA integrity (69.40 ± 0.47%) and mitochondrial potential (43.52 ± 1.44%) were significantly higher than other groups ($p < 0.05$ ). In the research 2 was to investigate the effects of present or absent 0.05 M sucrose into the vitrification extenders on the motility, viability, acrosome integrity, DNA integrity and mitochondria potential of French straw vitrified-thawed Alpine goat semen. The result showed adding 0.05 M sucrose into the vitrification extender (6% DMSO + 6% glycerol + 0.05 M sucrose, 6% EG + 6% glycerol + 0.05 M sucrose and 3%Acetamide + 6% glycerol + 0.05 M sucrose), in the motility, viability, acrosome integrity, DNA integrity and mitochondrial potential were significantly higher than not adding 0.05 M sucrose group (6% DMSO + 6% glycerol, 6% EG + 6% glycerol and 3%Acetamide + 6% glycerol) ($p < 0.05$). The research 3 was to investigate the effects of cryoprotectants adding at 37℃ or 4 ℃ on the motility, viability, acrosome integrity, DNA integrity and mitochondria potential of French straw vitrified-thawed Alpine goat semen. The results showed there are no significantly different on motility, viability, acrosome integrity, DNA integrity and mitochondrial potential between three treat group ($p > 0.05$). In the research 4 was to identify the three combinations (6% DMSO + 6% glycerol + 0.05 M sucrose, 6% EG + 6% glycerol + 0.05 M sucrose and 3%Acetamide + 6% glycerol + 0.05 M sucrose) ability of in vitro fertilization and the following-up embryos development. The results showed that the 6% DMSO + 6% glycerol + 0.05 M sucrose group in the cleavage rate (46% vs. 35% vs. 27%), 8~16-cell stage embryo development rate (19% vs. 12% vs. 5%), morula development rates (15% vs. 4 % vs. 0%) and blastocyst rates (8% vs. 0% vs. 0%) were higher than the other group.

*(T. C. Kang)*

## Sexing seman reproduction system

Flowcytometrical sorting of mammalian spermatozoa has been proven as a powerful tool for increasing the benefits in animal production, for the genetic improvement of farm animals, for the control of sex-linked disease in humans, and in wildlife for the re-population of endangered species. Although different techniques for sex separation of spermatozoa were developed in the past, the Beltsville sperm sexing technology is the only technique that enables the birth of offspring with desired sex in more than 90%. Several major improvements, like the invention of high speed cell sorting and improved orientation of cells in front of the laser, have been made in the past years. Nevertheless, the limitations of the technology due to the principle of single sperm cell analysis have to be recognized and even with further technical improvements it is unlikely that the output will reach the amount of a normal insemination dosage. The findings showed after the goat picks the essence, take 9% LDL TCG the base diluent adjustment density as 100,000,000 /ml 37 ℃ preservation. The subpackage dyes by 2uL 8.12 mM (H33342)/under 100,000,000 /ml 34 ℃1h conditions carries on the dyeing, separates the water temperature decrease to 4 ℃ to evade under the light condition to refrigerate before best the process condition. Each time takes 1 ml including 100,000,000 sperms, in the type 20000 sperm situations carries on sex screening on eruption pressure 60PSI each second, the recoverability do not separate above the sperm 4000/seconds, its sex accuracy chooses the scope rigorousness according to the frame to have the change, the estimate is above 90%.

*(F. H. Chu)*

## Low-dose insemination in pigs

The purpose of this study was concentrated on the evaluation of low dose artificial insemination by deep injection into uterus on sow. A total of 16 sows were separated into two groups randomly. The artificial insemination was operated by two concentrations $10\times10^8$ /dose and $30\times10^8$ /dose, respectively. Conception rate and litter size at born were assessed. The result showed that conception rates were 75% for $10\times10^8$ /dose and 87.5% for $30\times10^8$/ dose. The litter size were 7.17 for $10\times10^8$/ dose and 8.43 for $30\times10^8$/ dose. The development of this technique can add the value of elite boar via the application of frozen semen, cryopreservation semen and select sexed sperm.
*(Y. H. Chen)*

## Improvement of boar semen freezing efficiency

The frozen semen application on pig industry is not very common because of low viability and conception rate after thawing. The purpose of the trial focused on the effect of frozen and thawing on fertility and litter size, improving the fertility of artificial insemination. The result shows the fertility was 62.5% and average litter size was 8.2. The in vitro fertilization rate was 72.3% and 74.5% for frozen and fresh semen. There was no significant difference between two treatments.
*(Y. H. Chen)*

## The development of extender for rabbit artificial insemination

The purpose of the trial was aimed to develop an extender for rabbit artificial insemination. Four healthy and functional male New Zealand White rabbits were selected to collect semen for the trial. After semen collection by artificial vagina, semen quality (color, pH value, volume, concentration, mass motility and viability) was assessed for the evaluation of semen quality. Semen was dilute to $5\times10^7$/mL with two extenders, respectively. Then stored at two degrees of temperatures (4℃ and 15℃) comparing the effect of preservation for the semen between two extenders. The result showed that the viability of semen was decrease below 30% after 48 hours preservation diluted by the two extenders and stored at 4℃. The viability of which stored at 15℃ were all remaining above 30% after 96 hours of preservation. There was no significant difference for the characteristics of rabbit semen between two extenders. For the propagation of rabbit artificial insemination, we suggest store the diluted semen at 15℃ and inseminated before 96 hours to keep the successful fertilization.
(*H. H. Wu, M. Y. Tsai and C. H. Hsieh)*

Commercial extender and self-made extender

## The development of artificial insemination technique for rabbit

The purpose of this study aimed on the development of rabbit artificial insemination technique. Four healthy mature male rabbits were selected and semen was collected by artificial vagina then put into the incubator and transfer to the laboratory. Sperm concentration and activity were assessed. Sperms from different bucks were mixed and diluted to the concentration of $5\times10^7$/mL with test extender (extender A) and commercial extender (extender B) for artificial insemination. 20 New Zealand White breeding does with same age and similar body weight were selected and randomly assigned into two groups for the operation of artificial insemination ($2.5\times10^7$/dose) in cool season (January) and hot season (June). The result shows that the conception rates for extender A were 80% and 30% in cool season and hot season, respectively. Conception rates for extender B were 70% and 20% in cool season and hot season, respectively. Conception rate was higher in cool season than hot season.
(*H. H. Wu, M. Y. Tsai and C. H. Hsieh*)


The operation of artificial insemination

## The production system of minimal disease breeding geese

The purpose of this study was to set up the system of sterilizing controlled and eliminating pathogenic viruses, and then to improve the quality of egg and gosling production of minimal disease breeding goose in an environmentally controlled goose house. Goslings within 35 day old were infected easily by waterfowl parvovirus, especially that within one week old and caused high mortality. Therefore, it was the most important that establishing sterilizing controlled system. The lighting regime is 7L: 17D for 6 weeks and ration for resting stage was fed with limited amount. After that, the lighting regime was adjusted to 9L: 15D thereafter along with diet for laying stage fed ad libitum. One month later, the breeding geese entered reproductive season. After reproductive season, the breeders were fed with diet for resting stage. The diets for resting and laying stages contain 13 % and 18 % CP plus 2,350 and 2,650 kcal ME/kg, respectively. During raising period, we needed to eliminate pathogenic viruses, set up blood biochemical values and control raising environment of sterilizing and to reach the purpose of the quality of minimal disease egg and gosling.

*(S. C. Chang, M. J. Lin, K. C. Wu, S. R. Lee and Y. S. Jea)*

The goose house of minimal disease

## The improvement of fertility and hatchability of White Roman geese in an environmentally controlled goose house

This study was to investigate the effect of lighting regime treatment on the body weight gain and reproduction characteristics of White Roman geese kept in an environment-controlled house by using a complete randomly design. Thirty ganders and 90 geese were randomly assigned into four pens, each with 5 ganders and 15 geese. The 6 pens were randomly allotted into 3 lighting treatments (9L:15D, 11L:13D or 13L:11D). Each treatment was replicated 2 times in an experimental unit. The results showed that the geese under 13L:11D lighting treatment had a lighter body weight of ending experiment in comparison with under 9L:15D and 11L:13D lighting treatment (4.62 vs. 6.92 and 6.57 kg, $P < 0.05$) , respectively. The geese under 13L:11D lighting treatment had a shorter period in all stage of egg production in comparison with under 9L:15D and 11L:13D lighting treatment (90 vs. 177 and 107 d, $P < 0.0001$). The geese under 9L:15D lighting treatment produced more eggs than those under 11L:13D and 13L:11D lighting treatment (57.0 vs. 37.8 and 27.8 eggs/bird, $P < 0.01$), respectively. In conclusion, the increase lighting regime may induce shorter period of egg production in White Roman geese whereas the total number of eggs produced is lower.

*(S. C. Chang, M. J. Lin, K. C. Wu and Y. S. Jea)*

The environmental controlled goose house

## The improvement of growth and reproductive performances of White Roman geese in wet-pad forced ventilation house on summer

This study was to investigate the effects of two age at the first egg, i.e. age of 10 month and 12 month for laying period, and two molting, i.e. with molt and without molt on the body weight gain and reproduction characteristics of White Roman geese kept in an environment-controlled house by using a complete randomly design. Geese were randomly assigned to four treatments (2 ages at the first egg treatments × 2 molting treatments). Each treatment was replicated 2 times in an experimental unit. The

results showed that the geese under age of 10 month in comparison with those under age of 12 month had no significant improvement in body weight gain at the time when the geese were placed in the environment-controlled house. The geese under age of 10 month comparing to those under age of 12 month have heavier body weight at the time when the geese were at the peak of egg production (4.99 *vs.* 4.80 kg, P = 0.0297). The geese under age of 10 month comparing to those under age of 12 month have heavier body weight gain at the time when the geese were under 7 L : 17 D for 6 wks (0.264 *vs.* 0.089 kg, P = 0.0141), the geese under with molting comparing to those under without molting have heavier body weight gain (0.237 *vs.* 0.115 kg, P = 0.0441) at the same period. The geese under age at the first egg and molting treatments had no significant in fertility, hatchability, and hatchability of fertilized egg cross laying period. The geese under age of 12 month and without molting have longer laying period than other treatments. In conclusion, the geese under age of 10 month results in higher laying rate of all period and hatchability at ESP1 (stage of egg production from 0 to 35%). The geese under age of 12 month were molted, it could improve its laying rate of all period and hatchability at ESP1.

*(S. C. Chang, M. J. Lin, K. C. Wu and Y. S. Jea)*

The wet-pad forced ventilation goose house

## Effect of feeding time in early age on growth performance in Chinese geese goslings

The purpose of this study was to investigate the effect of feeding time in early age on growth performance in Chinese geese goslings. Two hundred and forty day-old Chinese geese goslings were divided into four treatments and each treatment included four replicates. The four treatments were goslings fed during 0, 3, 6 or 24 hours after post-hatch. Feed and water were supplied ad libitum during 0-2 weeks. The results indicated the effect of feeding time in early age on growth performance in goslings, especially in brown Chinese geese, but not in white Chinese geese. Daily body weight, average body weight and feeding efficiency of 1-2 week-old gosling fed during 0, 3 and 6h after post-hatch were significantly heavier and better than that during 24h after post-hatch ($P < 0.05$), contrarily, daily intake of these goslings were significantly more than that during 24h ($P < 0.05$). Therefore, the results showed goslings fed within 6h after post-hatch were improve their growth performance.

*(C. C. Hsiao, K. C. Wu and Y. S. Jea)*

## A study of RFID on production and management of breed geese

The objective of this study was to find out a suitable combination of the system RFID (radio frequency identification) technique for laying White Roman geese. Five hundred and thirty-two geese were randomly allotted into control and RFID treatments, each including 5 pens and 4 pens, each pen with 12 males and 48 females. The diets for laying stage were composed with 18% CP and 2,650 kcal ME/kg. The results showed that the geese entered into laying cage were 100%. The system could be correctly and stably operated on data collecting, recording and transmitting. There were 15.6% of geese did not produced eggs during laying stage, and 9.9% of geese just produced less 3 eggs/bird during the stage. Therefore, a total of geese which did not produced very well were 25.5 %.

*(S. C. Chang, M. J. Lin, K. C. Wu and Y. S. Jea)*

Raising of breed geese

## Effect of light-emitting diode on growth of White Roman geese

The objectives of this study were to examine the effect of different LED (light-emitting diode) light

sources on the growth of White Roman geese. Three spectra of LED light were tested: blue light (465 nm), green light (520 nm), yellow light (592 nm) and control group. Three hundred and twelve White Roman geese from hatching were used. They were divided into 4 treatment × 3 replications with 26 geese in each group. Light treatment was twenty-four hours light per day during 0-4 weeks,. Body weight and feed consumption were recorded at 0, 2, 4, 6, 8, 10, and 12 weeks of age. The results indicated that body weight of Roman geese rearing during blue and green lights were higher than the geese during yellow light at 0-4 weeks of age. The growth showed White Roman geese reared under green light had higher body weight than the control group in 5-8 weeks of age. The growth showed White Roman geese reared under green light had higher body weight (5,624 g) than the control group (5,370 g) in 9-12 weeks of age. If using LED to replace the traditional light bulb lamp, each lamp can save 1,250 NT dollars per year. The results showed that the above given green light irradiation was helpful to the growth advantages of speed and power. Therefore, LED-based lighting device had a potential for development.
*(C. C. Hsiao, Y. S. Jea and Y. H. Chen)*

## Establishment of embryo development figure in White Roman goose

The study objective was to structure the embryo image of geese during incubation period. The 10 fertilized eggs were used to test. Five of them were broken for anatomy and the other five for image processing. Information on embryonic development was to establish through observation by conventional anatomy. The results showed that after 1-2 days of incubation, the formation embryo development could be seen; 3-4 days, the yolk sac blood vessel formation and heart beat; 6 days after hatching, it showed spider-like blood vessels to expand; 7 days, the formation of black eyes; 8 days, the formation of wings and feet; 12 days, the eye size is fixed; 14 days, many blood vessels and feather growth and color depth; 20 days after hatching, rapid development of various parts of the body, gradually increasing the shadows inside the eggs; 23 days, the yolk sac size was significantly smaller; 27 days, the size of a fixed length; 29 days hidden in the belly of the yolk sac; 30 days hatched. Throughout the incubation period, the yolk sac size reduced with the increasing number of days, while during this days, embryo length, back width, wings and legs became larger with the incubation day increasing. The results of this study can be used as a reference for researcher and incubator in the future.
*(C. C. Hsiao, Y. S. Jea and Y. H. Chen)*

## Observations of growth performance and reproductive traits by articicial feeding Australian Black swans in Taiwan

The objectives of the study were to establish the basic data of growth and reproductive trait in Australian Black Swans within captivity and supplied the results as a reference to breeders. Trial 1, Thirty-six cygnets of Australian Black Swans were used to analyse growth performance in Chang-Hua station from 1992 to 1997. Trial 2, reproductive trait was collected from Sixteen Australian Black Swans in Chang-Hua station from September 2007 to February 2011. Trial 1, the results indicated that there was no significantly difference in the body weight of cygnets between male and female before 12 weeks of age. Nevertheless, male cygnet had higher body weight than that of female at 14 weeks of age ($P < 0.05$). Trial 2, the results showed that Australian black swan reached sexual maturity at 570-720 days of age and breeding season of birds occurred from September to next February. Birds had 1-4 clutches in each breeding season and each clutch interval lasted for more 30 days. Female swan laid 1-7 eggs at each clutch and the average egg number was 4.17. Birds laid egg every other day and the weight of egg was around 260 g. The incubation day of swan eggs ranged from 35 to 38 days. The fertility and hatchability were 42.23 % and 26.11 %, respectively. The reason for the lower fertility and hatchability were unknown. The above mentioned, Australian Black Swans could be raised by artificial feeding in Taiwan. The results of this study can be used as a reference to remote the raising technology in the future.
*(C. C. Hsiao, Y. S. Jea and Y. H. Chen)*

## Evaluation and utilization of duck semen stored in low temperature

The aim of this experiment was to evaluate the proper temperature for Muscovy semen liquid-storage.

Muscovy duck semen was diluted with commercial semen extender and stored in 4, 7, 10, 14 and 18℃ for 24 or 48 hr, respectively. Then 11 Kaiya ducks were artificial inseminated with each treated Muscovy semen. After single AI, eggs were collected for a period of 4 days for incubation. The fertility rate of semen stored in 4, 7, 10, 14 and 18℃ for 24hr were 66.7%, 85.7%, 81.3%, 36.7% and 48.4%, respectively, and were 41.3, 77.8 and 56.3% for storage after 48 hr, respectively. These results indicated that 7 ℃ is proper Muscovy duck semen liquid storage. And the fertility rate of liquid-storage semen after shipping will decrease 20%.

(*L. Y.Wei, H. C. Liu and J. F.Huang*)

Semen collection for Muscovy drake

## Dissecting the physiology function of ste20-Mst kinase on the mammary gland development (II)

We simplified the Tet-on system and make a single vector that contains the rtTA2s-M2 gene under the control of the cell-specific promoter (the mouse mammary tumor virus promoter) and TRE2 (TetCMVmin) promoter/mst4 or mst3 cDNA. This system could be expressed restrict to the epithelial cells of the mammary gland and be induced by doxycycline (Dox). We used such vector in mammary epithelial cells. The resulting vector could display the mst4 or mst3 expression with lower basal activity and higher inducibility. To define the transgene expressed was efficiently regulated by addition of doxycycline in culture media and determine the ability to control gene expression adjustably in mammary epithelial cells, we created a doxycycline-inducible, mammary-specific transgene system and the simply system is highly suitable for mammary-specific expression of mst4 or mst3. We created stable clone for above vector in mouse mammary epithelial cells and found that expressing mst4 could inhibit cell migration. We also produced their transgenic mice to dissect their physiology function on the mammary gland development, and verified transgene DNA insertion in these newborn mice.

*(J. S. Chao and C. L. Chang)*

## Dissecting the physiology function of ste20-Mst kinase on the mammary gland development (III)

A simplified tetracycline-on (Tet-on) system including all the required regulating elements was constructed in a single vector (poMRT$_{neo}$/GFP plasmid). The single vector contains a Tet-controlled transactivator gene, rtTA2s-M2, a mouse mammary tumor virus (MMTV) promoter, a GFP reporter gene under the control of Tet operator sequences (tetO) flanked with a minimal CMV promoter (TetCMVmin) and a mammalian selection marker neomycine 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-based Tet-on inducible vectors enabled the transgene not only to express in a particular type of cell, but also be tightly regulated under particular conditions. Next, we replaced GFP with a functional Mst4 gene, a sterile 20-like kinase, in this inducible system. The resulting vector could display the Mst4 expression with lower basal activity and higher inducibility. These data demonstrated that we have created a doxycycline-inducible transgene system and the simply system is highly suitable for mammary-specific expression of any gene of interest.

*(J. S. Chao and C. L. Chang)*

## Analysis of specific molecular markers and important genes in PGC from White Leghorn chicken

The purpose of this study is to investigate the developmental and pluripotentcy related genes expression profile of PGC obtained from day 5.5 and day 8.5 chick embryos after incubation. PGC was obtained by micromanipulation and the total RNA was purified by commercial kit. The cDNA was synthesized using RT-PCR with total RNA as a template. The genes expression was detected by real-time PCR using various kinds of primers and the results showed that all the genes detected were expression both in day 5.5 and day 8.5 chick embryos except the Blimpl. Some genes that selected from the chicken germ cell database were also showed expression both in day 5.5 and day 8.5 chick embryos. *Cvh* is an important gene and preferentially expressed in whole period of germ cell differentiation.We structured the siRNA of *Cvh*and transfect to PGCs to make sure it's function.After 24 hours transfection, the expression of*Cvh*in male PGCs was down-regulated, but not in female's PGCs.Then we compared male and femalespecific gene expression after siRNA treatment.*Pouv*up-regulated in both sex, indicated the PGCs prefer to stay in PGCs but germ cells. *Sox2*, *Sox9* also up-regulated lightly in male PGCs. In female PGCs, *LhX8* was down-regulated by siRNA, which is the important factor about maintain the oocyte and differentiated on early oogenesis. Our findings show that *Cvh* is a critical factor for maintenance and differentiation of the oocyte during early oogenesis, and it acts in part by down-regulating the *Lhx8* pathway.

*(S. J. Deng and J. W. Shiau)*

## Production of egg yolk immunoglobulin against *Escherichia coli* from White Leghorn and Lohmann chickens

This study investigates the immunization response of different breeds of chickens to Escherichia coli (E. Coli) antigen and the function of specific immunoglobulin in yolk (IgY) produced. The antibody was raised by the intramuscular immunization of White Leghorn hens and Lohmann hens with inactivated E. coli antigen either from a commercial vaccine (CM) or isolated from a local farm (AF). Anti-E. coli IgY antibodies were isolated using the water extraction method, and their E. coli inhibitory effects were then determined. The anti-E. coli IgY production levels of White Leghorn chickens/Lohmann chickens immunized with the CM and AF antigens were 65.28/55.78 μg/ml WSF and 48.31/14.4 μg/ml WSF, respectively. The specific IgY from White Leghorn chickens immunized with CM antigen exhibited a superior inhibitory effect on the growth of activated E. coli. The least effective concentration to inhibit the growth of activate E. coli for this specific IgY was 63μg/ml WSF. The passive protective effect of egg-yolk antibodies against E. coli K99 infection in neonatal piglets indicates that piglets treated with antibodies from the hens immunized against enterotoxigenic E. coli (ETEC) were protected against the deleterious effects of this organism.

*(J. F. Liou, J. W. Shiau and L. R. Chen)*

# Processing of Animal Products

## Development of high quality and exquisite animal products with the feature materials

The purpose of this experiment was to team up LRI and domestic animal industries to develop various animal products featured by native productive materials. For the sake of increasing the value-added and wildly extension of the animal products, some leisure foods and tourist souvenir should be developed to be kept at room temperature. Native chicken essence was mixed with Chinese herbs, from which some instant beverages were developed. Pressed pork jerky and pork stick were the semi-fermented meat products mixed with vegetables and fruits and then dried. Pressed pork jerky grilled after drying and made it $a_w$ value below 0.8 in order to keep quality at room temperature. Besides, the semi-moisture duck products which were processed in a different way under the interaction of $a_w$ value and pH control. Another distinctive egg product had been developed with salting, tea stewing and alkalizing to have three colors within eggs.

*(H. Y. Wu, R. J. Tu, H. C. Tsai, S. J. Lee and M. L. Lee)*

Native chicken essence mixed with Chinese herbs


An instant beverage of native chicken essence with Chinese herbs

Pressed pork jerky

Semi-moisture duck product

Egg products reveal three colors and flavors

## Development of the meat products suitable for the elderly people

The concepts of low-fat, low-salt and easy-digested meat products are good for elderly people and these products are popular in modern diet. For this purpose, several kinds of fried and barbecued meat products had been developed. These products contained pork loin ham with anka sauce, one kind of fried pork steaks with anka sauce, 3 kinds of fried pork steaks and one kinds of chicken breast steak with different flavor. All products kept at 3℃ for three months had been staying at good state at TBA value and total plate count.

*(H. Y. Wu, R. J. Tu, S. J. Lee and M. L. Lee)*

pork steak with curry

pork steak with caramel and grapefruit flavor

pork steak with scallion

chicken breast steak with pineapple flavor

pork steak with anka sauce

pork loin ham with anka sauce

## Development of ready-to-eat collagen products from poultry by-products

The aim of the study was conducted to develop ready-to eat collagen products by using poultry by-product, including broiler feet, broiler skeleton and broiler cartilage. The technology of extraction and purification were utilized for producing poultry collagen product. Results showed that the broiler feet, broiler skeleton and broiler cartilage could be extracted collagen successfully. According to the map of SDS-PAGE, the broiler skeleton had low concentration of collagen, but the broiler cartilage had high type 2 collagen content because it has higher ratio of α1 Chain / α2 Chain than that broiler feet.

(*W. S. Chen and Y. K. Lin*)

Collagen from broiler skeleton

Collagen from broiler feet

Collagen from broiler cartilage

## The study of smoking woods and microorganism for producing dried sliced poultry products

The purpose of this experiment was to develop dried sliced poultry meat products (chicken, goose and duck breast meat) by using incubation of microorganisms (*Penicillium chrysogenum* and *Debaryomyces hansenii*). Analytical items including chemical compositions (moisture, crude fat, crude protein and ash), pH, water activity, meat color, TBA, flavor compounds, hydrolyzed amino acid composition and fatty acid composition. Results showed that the sliced chicken meat had higher moisture, crude fat and water activity than those of any other spices. The dried sliced goose meat had higher pH value, TBA value and hydrolyzed

amino acid composition than those of any other spices. The dried sliced chicken meat had higher myristic acid, palmitic acid, linoleic acid and arachidonic acid than those of any other spices. According to the results of flavor compounds, there were 12 flavor compounds came from fat oxidation of meat, 17 flavor compound derived from Maillard reactions of meat during heating and 13 flavor compounds came from the smoking materials during meat processing.
(*W. S. Chen, M. L. Lee and Y. C. Chen*)

Dried sliced chicken meat

Dried sliced duck meat

Dried sliced goose meat

## Development of fermented meat products. Ⅴ. Study on the manufacturation of new style fermented meat products

The objective of this study was to investigate microbial and physicochemical characteristics of fermented sausages inoculated with *Leuconostoc mesenteroides* N35, which isolated from local natural fermented ham. Fermented meat products were inoculated with starters, *Lactobacillus sakei,* (A) and starter combined with *Leu. mesenteroides* N35 (B), both microbial used for producing the marinated ground pork. Results revealed that starter treatment had no significant difference in water contents, water activities and weight loss while compared to natural fermented sausage (control). The pH of the starter treatment dropped rapidly to 4.8 within 48hrs and had slightly risen up to pH5.0 at the final stage of fermentation. Besides, the pH value of the control slowly fell to 5.0 at the beginning of fermentation. No pathogen had been detected from both samples in final products. The results showed that the flavor and texture of marinated ground pork contained 20% or 40% of fermented meat, were inoculated with starter A or B had a good acceptability.
*(R. J. Tu, H. Y. Wu, T. L. Chen and M. J. Chen)*

Marinated ground pork contained fermented meat

## Development of semi-solid meat and dairy products for leisure life

Fruit yogurt has a similar shelf-life to plain yogurt, a similar smooth creamy texture and a sweet-sour taste with the characteristic flavor and color of the essence or fruit that is added. There is a problem in the dairy factory in Taiwan. If they selected fresh fruit to manufacture fruit yogurt, the naturally micro-organisms and enzymes that would cause changes the color or flavor of the fruit and sometimes with whey separation of the yogurt products. The aim of this study was to find some methods and settle the above-mentioned problems. Also, the study was conducted to develop ice cream with a creative flavor. Fermented meat products were inoculated with *Lactobacillus sakei* and *Leu. mesenteroides*, which were isolated from local natural fermented ham, then used for producing the marinated ground pork with a sour and salty flavor. After that step, ice cream, which was made of milk, cream, condensed milk, was added 3 or 5 or 10% marinated ground pork. The results showed that the flavor and acceptability of ice cream contained 3% or 5% of marinated ground pork were better than other treatments.
*(C. Y. Kuo and R. J. Tu)*

Yogurt with mango

Ice cream contained 5% of marinated ground pork

## Development of the diverse goat meat products in Peng-Hu

This study was conducted to develop the goat meat products and to assist Peng-Hu to pave the way for sustainable goat industry. The living goats were purchased from local farms, slaughtered and then cut into shoulder, belly and ham. There were six kinds of goat meat products to be made, including dry-cured goat meat, smoked meat, wined meat, deboned ham, pressed ham and sausage. All products contained salt below 1.6%. Smoked goat meat and dry-cured goat meat had been carrying out in continual three days pasteurization in order to get a longer shelf-life at room temperature. The results showed that the wined goat meat and pressed ham were kept at 3℃ for three months and still retained a good quality in total plate count at 1.4 or less than 1.0 log CFU/g, and TBA value at 0.81 or 0.29 mg/kg, respectively.

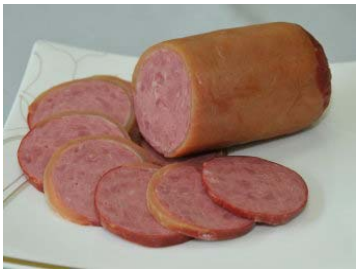
*(M. C. Lu, H. Y. Wu, R. J. Tu, S. J. Lee and M. L. Lee)*


Dry-cured goat meat


Smoked goat meat


Wined goat meat

Deboned ham with skin



Pressed ham with skin

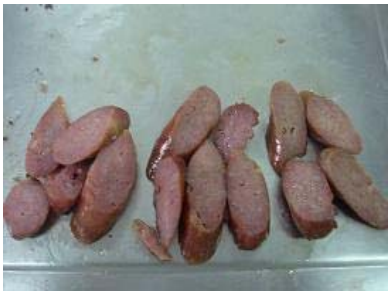
Sausage with goat meat

## Effect evaluation of using *Toona sinensis* leaf extract to safe animal products

The purpose of the study was to investigate the effect of adding *Toona sinensis* powder into sausage processing procedure on the microbial growth and antioxidation activity of sausage. Various dosages of the *Toona sinensis* powder were added into Chinese-style sausage. The analyzed items of sausage were pH values, total plate counts, *Lactobacillus*, *Micrococcus* counts, water activity, color evaluation,

TBARS values and sensory evaluation. The total plate counts of samples were increased following extended the storage period. The total plate counts of adding *Toona sinensis* sausage were still below 7.0 log CFU/g after 6 weeks food processing. The *Lactobacillus* counts were also increased at storage experiment and were obviously increased after the fifth week storage. The *L* values of the treated groups were lower than that of in the control group. The TBARS values of sausage varied within a narrow range during the storage periods. The treated groups with adding low dosage of *Toona sinensis* powder into sausage were unaffected for the sensory evaluation. In conclusion, Chinese-style sausage with the low dosage of the *Toona sinensis* powder had capabilities of the microbial inhibition, antioxidation activity, extending of the product shelf-life and health functionality of products.
(*T. C. Wan, C. M. Chen and C. Y. Lin*)

Appearances of Chinese-style sausage with Toona sinensis



Slices of Chinese-style sausage with Toona sinensis

## Development of egg-flavored frankfurter

This study was to develop a good-quality egg-flavored frankfurter. Pork was used as the major material, with addition of alkalized egg or salted egg. Four recipes were formulated and then products are produced based on the recipes. The pH value, TBA value, total plate counts, and sensory evaluation of products were investigated after storage of 0, 2, and 4 months to understand the changes of flavor, texture, and quality. According to our results, the pH values of all groups were at the range of 5.99 to 6.27. After frozen for 4 month, the pH values were between 5.92 and 6.28. The pH values of the egg-flavored frankfurter did not varied during storage period. The total plate count of all groups had no significant difference after 4 months of frozen storage, with less than 3 log CFU/g under the storage. The sensory evaluation of all groups stored at -18℃ for 4 month were more than 4, and the quality of the egg-flavored frankfurters was good and accepted by the consumers.
*(J. H. Lin, J. F. Huang, C. H. Su and C. H. Cheng)*

The egg-flavored frankfurter products

## Research and development on duck meatball and duck egg omelet with salted radish

This study was conducted to develop the duck meatball and duck egg omelet with salted radish and to investigate the changes of their quality during storage. Pork and fresh duck meat were used as the major materials to make the meatball in the Experiment I; Fresh duck egg and salted radish were employed to make duck egg omelet in the Experiment II. Two experiments were divided into four formula treatments and final products were stored at -18℃ for four months. The pH value, TBA value (thiobarbituric acid), total plate counts and sensory evaluation were measured. Results of experiment I showed that no significant difference were observed in duck meatball in total plate counts after stored at -18℃ for four months and total plate counts of all treatments were below 3.30 log CFU/g. In sensory evaluation, all duck

meatball products had high overall acceptability score after stored at -18℃ for four months. Results of experiment II showed that TBA value of all duck egg omelet within 1.93~2.75 ppm were observed in the initial period, however, the TBA value of all products were increased with prolonged storage period. All duck egg omelet products had high overall acceptability score after stored at -18℃ for four months.

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

Duck meatball products stored at -18℃

Duck egg omelet products

## Purification and development of poultry oils

In poultry industry, there were lots of skin and fat tissue had been discarded or used in animals feed, which caused the waste of the resources seriously and the huge treatment cost. The poultry fat is a kind of good materials for food because of the liquid state at room temperature, high smoke point, high content of monounsaturated and the linoleic acid which is one of the essential fatty acid in human bodies, and the special odors. After tasting, the confit de canard and the instant sources made by ducks and geese fat were been taken as successful products because of their characteristic. During the cold storage for 3 months, the total plate counts in the confit de canard was lower than 3 log CFU/g, and the acid value was lower than 0.8 mg KOH /g in instant sources.

(*H. J. Lee, M. R. Lee and H. Y. Wu*)

The confit de canard was preserved well by the duck oil

The chilli sauce was made by goose oil

## Research on the egg white hydrolysates as antioxidant in emulsified meat products

The aim of this work was to research the effect of duck egg white hydrolysates (DEWH) addition on the antioxidation of fat in meatballs during 14 days of refrigerated storage (4℃). Results show that the peroxide values (PV) of DEWHP (DEWH lyophilized powder)-added and DEWH-added treatments were lower than control group. It involved the primary oxidation products in the lipid fraction of meatball were inhibited by DEWH. That presented DEWH had the antioxidation of lipid in the meatball. All of tests were no significant difference on TBARS value (1~2.1 mg MDA/kg). The reason of results may be just for 14 days chilled storage that caused the secondary products of lipid oxidation in meatball to non-formation yet. Total plate counts of these products were low (less than $10^3$ cfu/g). There were no significantly difference in texture profile analysis (firmness and toughness) and color among all treatments.

(*Y. C. Chen and W. S. Chen*)

Manufacture of meat ball

## The establishment of commercial model on the reutilization of Pidan making pickle solution

The objective of this study was to investigate the changes of main components of pickle solution during pickling period and effects of adjusted pickle solution on Pidan making yield. Results showed the pH value, NaOH and NaCl concentrations in pickle solution were gradually decreased during 14 days pickle period. The used solution was adjusted equal to the original solution level by adding NaOH and NaCl for reutilization. The yield of original pickle solution (OPS), the first and second adjustment of used pickle solution (UPS) on Pidan making were over 90%. The MUOPS (1/1), which was the mixture of UPS and OPS (UPS/OPS = 1/1), was the best for the commercial model of UPS reutilization (the yield of Pidan making was up to 94.1%).

(*Y. C. Chen, J. H. Lin and H. P. Su*)

Appearance of Pidan

Pidan products used pickle solution

## Studies on characteristics of Jersey's milk and development of distinctive products

The raw milk qualities of Jersey and Holstein cows from LRI were compared from 2008 to 2010. The result showed that the components of fat, protein and total solid in Jersey's milk were higher than those in Holstein's milk. The somatic cell count of Jersey's milk in summer season was lower than those in Holstein's milk. The raw milk was centrifuged and divided into cream and low fat milk. The low fat milk was utilized for producing yogurt and kefir within 0~48 hours incubation. The result showed that lactic acid content of the product trended to increase with fermentation time prolong. In yogurt experiment, there was higher than 10 g/L lactic acid productivity when above 24 hours fermentation time. In kefir treatment, there was higher than 10 g/L lactic acid productivity when above 12 hours fermentation time. Both of two kind fermented milk, the kefir incubated for 48 hours had the highest lactic acid productivity about 17.61 g/L. Whey separated from yogurt and kefir for 24~48 hours fermentation. Disk diffusion method was used for investigating the antibacterial activity of yogurt and kefir whey. Result revealed that two kind of whey were active against pathogenic genera *Pseudomonas fluorescens*. The antibiotic activity of kefir whey was better than the yogurt's. According to the above-mentioned, the reduced fat kefir could be a new bio-material used for skincare products.

*(C. Y. Kuo, T. F. Shiao, S. J. Lee and M. L. Wang)*


Care products made by kefir whey

## Detection of reconstituted goat milk in raw goat milk

It is difficult to distinguish the difference between the heating goat milk and the reconstituted goat milk. In the past, researchers were focus on thermal denaturation of protein and fluorescent material of Millard reaction products to distinguish them. In this study, we used determination of lactulose concentration to distinguish the difference between the heating goat milk and the reconstituted goat milk. Lactulose was formed by isomerization of lactose and be regarded usefully to distinguish UHT and sterilized milk. In this experiment, we used Resorcinol-HCl solution adds in different degrees of heating milk samples, measured the absorbance at 482nm. The method is rapider and simpler than HPLC, GC and other methods and detect limits was 70.0μg/ml. The raw goat milk had 3.06 mg/mL lactulose. The raw milk heated with 0~90 min and the lactulose content trended to increase with heated time. There was 3.63 mg/mL lactulose when raw milk heated with 90 min.

*(M. R. Li and C. Y. Kuo)*

## The investigation and analysis of goat milk in Taiwan and detection of reconstituted goat milk in raw goat milk

The qualities of raw and fresh goat milk in Taiwan were investigated in February, April, June, August and October of 2011. The fat and solids-not-fat (SNF) percentage of raw milk had the highest value in Feb. were 3.49 and 8.74, respectively, and had the lowest value in Jun. were 3.05 and 8.07 %. During experiment period, there were 8 and 39 % of raw and fresh goat milk could not fit CNS standard. A FAST (fluorescence of advanced Maillard products and soluble tryptophan) method for identification of reconstituted goat milk in the fresh goat milk was evaluated. This method is based on the simultaneous determination of protein denaturation by Trp fluorescence and the formation of fluorescent advanced Maillard products in the goat milk. The Trp fluorescence value of raw goat milk had the highest value, and then was reconstituted milk and fresh milk had the lowest value. This might be the protein of local goat milk easier denatured than the import goat milk powder. To determine 6 fresh goat milk and detected their Trp, AMP and FAST value were different. This might be the heated treatment was difference among six dairy factories.

*(M. R. Li and C. Y. Kuo)*

Market fresh goat milk

## Effects of processing methods of velvet antler from Formosan Sambar deer on quality and immunomodulatory activities

The purpose of this study was to investigate the chemical compositions and microbial quality of Formosan sambar deer velvet products, and the effects of velvet antler (VA) extracts on the anti-infective and anti- inflamed activities. Fresh VA was chopped into four sections. From top to bottom were the tip, the upper, the middle and the base sections, respectively. The chemical compositions in fresh and powder of VA were compared. The moisture content of four sections fresh VA were range 60.6 ~ 67.6 %. After dry treatment, the moisture content was just only 0.14 ~ 2.37 %. Crude protein was the second main composition in fresh VA, range from 17.2 ~ 21.7 %. The protein content became the main composition after dry treatment, and was 47.2 ~ 60.1 %. The tip had the highest protein content. The results of microbial quality of VA products showed that the tip of fresh VA had the highest total bacterial counts, and it was 4.24 log CFU/g (wet weight). The VA treated by oven or soaked in wine by one month, and there were no bacterial counts can be detected. For *in vivo* study, animal tests in *S. aureus*-infected mice demonstrated that the numbers of infected bacteria in the kidneys and peritoneal lavage fluid of *S. aureus*-infected mice were significantly higher ($P < 0.05$) than those found in the same organs of mice orally administered with the VA boiled or VA powder. Moreover, the mice were pretreated with VA boiled and 5 mg/20g body weight or high dosage of VA powder produced significantly lower levels ($P < 0.05$) of pro-inflammatory cytokines, IL-6 and TGF-β1 than the positive control group.

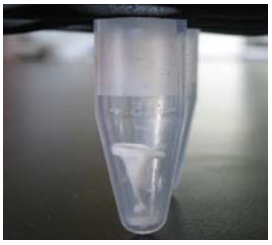
Velvet antler products of Formosan Sambar deer

Furthermore, the *in vivo* anti-allergic activity of the VA powder was performed by ovalbumin (OVA)-sensitized mouse model. The concentrations of total IgE and OVA-specific IgE in sera of OVA-sensitized mice were significantly lower ($P < 0.05$) than administrated VA powder for 4 weeks. Besides, the *ex vivo* results indicated that the secretion of Th1 (TNF-α, IL-2, IFN-γ) and Th17 (IL-17A, IL-17F, IL-21) cytokines by splenocytes were significantly increased ($P < 0.05$) in the VA powder-administered mice groups.In conclusion,

this study demonstrated the protective effects induced by the VA samples in *S. aureus*-infected and OVA-sensitized mouse models. The protective mechanisms of the VA samples might include a Th1 responses immune enhancer and a pro-inflammatory cytokine modulator.
*(C. Y. Kuo, C. H. Wang and M. J. Chen)*

## Purification and characterication of casein phosphopeptides from kefir

According to Nutrition and Health Survey in Taiwan, calcium intake was below Recommended Daily Nutrient Allowances (RDNA). Milk is the best source of calcium supply for human. Kefir is a beverage produced by lactic-alcoholic fermentation of milk using kefir grains. The bioactive peptides released from casein by proteolysis during fermentation. The purpose of this study was to purify the casein phosphopeptides (CPP) from kefir and analyse its bioactivity. CPP in kefir were prepared by $CaCl_2$ aggregation/ethanol precipitation method. The amounts of CPP from reconstituted milk fermented kefir were higher than the fresh milk fermented kefir. CPP improved calcium absorption by binding with the calcium, both the kefir fermented by fresh and reconstituted milk, the calcium content were higher than the non-hydrolyzed casein. Phosphopeptide enrichment spin columns were used for CPP purification, and the lyophilized fractions were further assay by RP-HPLC.
(*M. L. Wang and C. Y. Kuo*)



The CPP product from kefir

## Production of kefir cheese

Kefir is a mixed of culture consists of lactic acid bacteria, yeasts and acetic acid bacteria. Kefir as a starter culture for making kefir cheese, the moisture content and crude fat was about 50% and 20%, respectively. Cheese increased proteolysis during ripening. The counts of total aerobic bacteria, lactic acid bacteria and yeasts were increased until the 14th day of ripening. The pathogenic microorganisms and molds were no observed in kefir cheese. The by-product of cheese-whey was used for making whey-cheese. Kefir whey cheese had moisturizing texture because whey protein has gelation properties.
(*M. L. Wang and C. Y. Kuo*)

Kefir cheese

Whey cheese

## Effects of temperature, concentration of rennin, lactobacillus and salt on production of goat cheese

The supply of goat milk is normally over the demand in summer due to the seasonal breeding and lactation of dairy goats in Taiwan. Processing of goat milk for cheese is one of measures to utilize the surplus of milk. In this study, the effects of temperature (25 ℃ *vs.* 37 ℃)and concentration of rennin, *lactobacillus* and salt in raw milk on the formation of curd and the taste of cheese were investigated. The results showed that there were higher forming rate of curd and exclusion of whey at 37 ℃. Addition of 0.15% and 0.2% rennin favored the curd formation. Addition of 3% salt in milk elevated significantly the content of ash in cheese. Addition of 3% of *lactobacillus* in milk resulted in over $10^7$ CFU/g of *lactobacillus* in goat cheese. The growth of *lactobacillus* in cheese was restrained while the content of salt in cheese elevated. The results of chemical analysis showed that goat cheese contained glutamic acid (3204.4~3545.3 mg/100g), leucine (1599.5~1762.5 mg/100g), oleic acid (29.65~29.80%), and palmitic acid (20.75~20.85%) though there were no significant difference among treatments. No *Coliform* group, *Salmonella sp.*, *Staphylococcus aureus* were found in the culture of cheese. These

results offer the database for further study on making of goat cheese in Taiwan.
(*J. S. Shiu, C. J. Feng and J. C. Haung* )


Goat milk cheese


Goat milk cheese

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(*J. S. Shiu, C. J. Feng and J. C. Haung*)


Goat milk cheese

# Livestock Management

## Investigation of antibiotics resistant gene and microorganism in hog farm

The aim of this study is to investigate the effect of using antibiotics in livestock industry on the environmental microbes. Two pig farms were investigated in this study. Farm A applied antibiotics in feeds as a grow promoter, while farm C did not. The numbers of antibiotics resistant bacteria in the feces, compost, soil and wastewater were counted by culturing on TSA and LA medium with chlorotetracycline (CTC). The results showed no significant differences between there two farms for some samples. The results of PCR reacts using *tet*A, *tet*B, *tet*D, *tet*E, *tet*G, *tet*M, *tet*O, *tet*S, *tet*M and *tet*Q as primers showed almost all the samples got predict products. The results coincided with that of resistant bacteria, means the CTC resistant microorganisms also existed in the environment of farms using no antibiotics as the feed additives. The results of the identification of CTC resistant bacteria showed there were *Corynebacterium* spp. in feces samples from both farms. However, the distributions of CTC resistant bacteria in two wastewater treatment systems were different. The microbes profile of effluents of farm C was mainly *Bacillus* spp., and some *Alcaligenes spp.* and *Escherichia coli*, while that of farm A was diverse, which contained *Comamonas*, *Rhodococcus*, *Providencia*, *Stenotrophomonas* spp.

*(M. P. Cheng)*

## Feasibility on application of fiber in animal feces

The aims of this study were to screen a fribrolytic bacterium from cow feces or rumen to develop a novel cellulase or xylanase to promote the hydrolysis of fibers in animal feces and the production of methane as an energy resource, and to reduce the pollution from animal house. *Bacillus subtilis* XR1 and *Clostridium* sp. XR61 which could degrade xylan were isolated from rumen of cow. The former grow under both aerobic and anaerobic conditions, while the latter grow only under anaerobic condition. *B acillus licheniformis* XF12 and *Paenibacillus macerans* which could degrade xylan, *Psedomonas aeruginosa* AF4 which could degrade avicel, and *Bacillus cereus* CF3 and *Paenibacillus macerans* CF51 which could degrade CMC were isolated from feces of cow. The intra- and extra-cellular fribrolytic enzyme activities of these strains were measured after 1 week of incubation under 40$^{o}$C. The results showed the activities of extra-cellular enzyme were significantly higher than those of intra-cellular ones. The crude extra-cellular enzymes collected by centrifugation reacted with substrate under pH 6 to 8. The results showed strains *B. licheniformis* XF12 and *B. cereus* CF3 had highest activities at pH8 , while other strain at pH7. The extra-cellular enzyme activities were the highest at day 2 to 4, and decreases at day 7.

*(M. P. Cheng)*

## Effect of aeration on greenhouse gas emission from the composting process of swine manure

The purpose of this study was to evaluate the effect of aeration condition on the greenhouse gas (GHG) mission from the composting process of swine manure. The swine manure was piled in the composting plant X, Y and Z with 3, 0.5 and 0 min/hr of aeration, respectively. The temperature of compost was recorded daily. The GHG from the compost was measured 3 times a week. The composition of compost was analyzed weekly. According to the changes the temperature and height of the compost, the hydrolysis rate of organic matter was X > Y > Z. The results of evaluation of the methane concentration of headspace gas of compost plants showed the methane production was negative correlative to the aeration rate. The Z compost without aeration produced the highest amount of methane. The nitrous oxide concentration of swine manure compost was as low as 0 to 3.43 ppm. On a whole, the amounts of methane and nitrous oxide were higher before next turning process of compost. The inner of compost was under the anaerobic condition before turning might be the reason of the nitrous oxide produced by denitrification process and the methane

produce from organic acids by methanogenesis process. The results of this study showed aeration during the compost process can accelerate the degradation of organic matters, shorten the period of composting, and reduce the production of methane from the compost. *(M. P. Cheng)*

## Studies on reducing the feces excretion of copper and zinc in chicken

The purpose of this study was to investigate the effect of dietary supplementation with different levels of copper and zinc on the production performance and copper and zinc excretion of laying hens. A total of 288 Hy-Line W36 birds, during from 24 to 27 weeks age the hen-day production above 90% of birds. A corn-soybean meal diet without copper and zinc supplementation, containing 17% of CP and 2,900 kcal/kg of ME was used as a basal diet. A 2 ×3 factorial arrangement of treatments consisting of feeding the basal diet with two supplements of Cu and three supplements of Zn, i.e. without (Cu-0) and with 10 mg/kg (Cu-10) of copper and with 30 (Zn-30), 60 (Zn-60) and 90 (Zn-90) mg of Zn/kg, by adding Cu $SO_4$ and $ZnSO_4$, respectively. The experimental period during 28 to 56 weeks old of birds were fed *ad libitum* of diet and tap-water. Production performance, copper and zinc concentration of diet and feces were measured. The results showed that the different copper levels of diet did not affect the egg weight, hen-day production, feed intake and feed conversion ratio. The laying hens of intake Cu-10 diet had significantly thicker ($P < 0.05$) eggshell thickness, smaller egg mass and eggshell breaking strength ($P < 0.1$) than intake Cu-0 diet birds. Laying hens of intake Zn-90 diet had significantly higher ($P < 0.001$) fecal excretion than birds of intake Zn-30 diet. However, the Cu and Zn concentration in feces was increased ($P < 0.001$) along with Cu and Zn intake increased.

*(T. M. Su, S. M. Liou, Y. H. Weng, T. H. Hsiao and H. F. Lee)*

## Studies on reducing the content of nitrogen and phosphorus in pig feces excretion

The purpose of this study was to investigate the dietary supplementation levels of nitrogen and phosphorus to reduce the excretion of nitrogen and phosphorus in pig. A total of 48 LYD pigs, with averaged body weight BW) 41.7 kg, half barrow and half female were used. Pigs fed with one of four corn-soybean meal diets, which contained DE 3,400 kcal/kg and crude protein (CP) 18% (diet A), 16% + AA (diet B), 14% (diet C) and 12% + AA (diet D), respectively. Pigs were randomly assigned into four feeding treatments with 12 replicates each, and 1 head in each replicate. The pigs of group G1 fed with diet A in growing period (initial to BW 70 kg) and diet C in finishing period (BW 70 kg to end), respectively. Group G2 fed with diet A on the first day then subsequently reduced 0.03% of CP daily throughout the experimental period. The pigs of group G3 fed with the diet B in growing period and diet D in finishing period. Group G4 fed with diet B on the first day then subsequently reduced 0.03% of CP daily throughout the experimental period. Feed and water were provided *ad libitum* during the experimental period. Once pigs were 55 and kg 90 kg, four pigs in each group were selected and fed in individual metabolic cage for sample collection. Total feces and urine were collected and recorded. Growing experiment was finished once pigs were 110 kg in average and six heads, half barrow half gilt in each group were randomly selected and slaughtered for carcass trait measurement. The growth performance, carcass trait, nitrogen and phosphorus concentration of diet, feces, and urine were measured. The results showed that the average daily gain, average daily feed intake, and feed efficiency (gain/feed) were similar among treatments. The pigs of group G2 had longer ($P < 0.05$) carcass length than the group G3. Group G4 had higher and thicker ($P < 0.05$) dressing percentage and backfat thickness than the group G1. But the age of slaughter, live weight, carcass weight, percentage of lean and percentage fat were not different for all pigs. In growing period, group G2 had higher ($P < 0.05$) fecal nitrogen concentration in dry matter basis (FN-DM) than the G4 group, and higher ($P < 0.05$) FN-DM than the groups G3 and G4 in finishing period. The pigs of group G1 had higher ($P < 0.05$) FN-DM than the groups G3 in growing and finishing period.

*(T. M. Su, S. M. Liou, Y. H. Weng, T. H. Hsiao and H. F. Lee )*

## Studies on reducing the excretion of fecal copper and zinc in chicken

The purpose of this study was to investigate the effect of dietary supplementation with different levels of copper and zinc on the production performance and copper and zinc excretion in laying hens. A total of 192 Hy-Line W-36 birds of postmolt were used once the production rate was above 90% during 67 to 71 weeks of age. A corn-soybean meal diet without copper and zinc supplementation, containing 17% of CP and 2,900 kcal/kg of ME was used as the basal diet. A 2 × 3 factorial arrangement of treatments consisting of feeding the basal diet with two supplements of Cu and three supplements of Zn, i.e. without (Cu-0) and with 10 mg/kg (Cu-10) of copper and with 30 (Zn-30), 60 (Zn-60) and 90 (Zn-90) mg of Zn/kg, by adding Cu $SO_4$ and $ZnSO_4$, respectively. Feed and tap water were fed *ad libitum* during the experimental period from 72 to 95 weeks old of birds. Production performance, copper and zinc concentration of diet and feces were measured. The results showed that the different copper levels of diet did not affect the egg weight, hen-day production, egg mass, feed intake, eggshell, eggshell breaking strength and feed conversion ratio. The laying hens fed with Cu-10 diet had significantly higher ($P < 0.01$) copper concentration of plasma, and copper concentration and dry matter of feces, but had lower calcium ($P < 0.1$) and phosphorous ($P < 0.05$) of plasma. The laying hens fed with Zn-90 diet had significantly higher ($P < 0.001$) zinc concentration of fecal dry matter than the Zn-60 and Zn-30 groups. The birds of Zn-90 group had lower ($P < 0.001$) dry matter of feces than birds fed with Zn-60 diet. In this experiment, dietary supplementation with different levels of copper and zinc effect did not the production performance. However, the Cu and Zn concentration in feces was increased ($P < 0.001$) along with Cu and Zn intake increased.

*(T. M. Su, S. M. Liou, Y. H. Weng, T. H. Hsiao and H. F. Lee）*

## Studies on reducing the content of nitrogen and phosphorus in broiler feces excretion

The purpose of this study was to investigate the dietary supplementation levels of nitrogen and phosphorus to reduce the excretion of nitrogen and phosphorus in broiler. A total of 528 1-d-old Arbor Acres commercial broilers, half male and half female, were into a 2 × 3 factorial arrangement of treatments. Two experiments were conducted exp. 1) used 480 birds and exp.2) used 48 birds with experimental animal. Broilers fed the basal corn-soybean meal diet with contained ME 3,200 kcal/kg and 4 mg Cu/kg and 40 mg Zn/kg consisting of feeding the basal diet with two supplements of crude protein (CP) and three supplements of phytase (PT). The birds of group CC fed contained CP 23% and CP 20% in grower period (1 to 21 d-old) and finisher period (22 to 35 d-old), respectively, and group CA fed diet with CP 20% plus amino acid (CP 20 + AA) and CP 17% plus amino acid (CP 17 + AA) in grower period and finisher period, respectively. Diet of broilers amino acid content of group CA to adjust by adding lysine, methionine and threonine equal the diet of group CC. The birds of groups PT 250, PT500 and PT 750 fed diet contained phytase 250, 500 and 750 U/kg in grower-finisher period, respectively. Feed and water were provided *ad libitum* during the experimental period. The birds of exp. 1) for growth performance and feeding cost were measured and exp. 2) once broilers were 8 birds in each group were selected and fed in individual metabolic cage for sample collection. The results showed that the average daily gain (ADG), average daily feed intake (ADFI), feed efficiency (gain/feed, G/F) and feeding cost were similar of groups CC and CA. The birds of group PT 750 had larger ($P < 0.05$) ADG and ADFI than the group PT 250. In the finisher period, the birds of group CC had higher ($P < 0.05$) blood urea nitrogen and phosphorus concentration of plasma than the group CA, and the birds of group PT 750 had higher ($P < 0.05$) urea acid and phosphorus concentration of plasma when compared to the group PT 250. The dietary supplementation different levels of CP compounds did not affect the carcass trait. The birds of group PT 750 had larger ($P < 0.05$) live weight and carcass weight than the group PT 250. For fecal chemistry compositions, the group CC fecal dry matter basis (FDM) had higher ($P < 0.05$) copper and zinc concentration in overall experiment period, and higher ($P < 0.05$) nitrogen and phosphorus concentration in grower period, respectively than the CA group. The birds of group PT 750 had higher ($P < 0.05$) phosphorus concentration of FDM in grower and finisher period, zinc concentration of FDM in grower period, and copper

concentration of FDM in finisher period than the group PT 250, but had lower nitrogen and phosphorus concentration in FDM when compared to the group PT 250. In conclusion, the dietary supplementation crystal amino acid and reducing the content of crude protein in diet did not affect the growth performance for broilers and could reducing the content of nitrogen, phosphorus, copper and zinc in FDM. Furthermore, the birds of group PT 750 had effects of improved ADG and ADFI and decreased excretion of phosphorus when compared to the group PT 250.

*（T. M. Su, S. M. Liou, Y. H. Weng, T. H. Hsiao and H. F. Lee）*

## Removal of the ammonia and odor from composting process by using trickling filter

There were two trickling filters used in this study. Filter A was inoculated with ammonia-oxidizing bacteria. Filter B was pH controlled. The exhausted gases of broiler litter composting process were conducted to these two bio-trickling filters to reduce the $NH_3$ and odor emission. The gas contact times (GCT) were set at 11, 15 and 25 seconds for both filters. The temperatures rose to more than 65℃ and was maintained for over 3 days during composting process. A peak of the $NH_3$ and odor emissions was observed with the thermophilic stage. The odor and ammonia concentrations of the exhausted gas significantly ($P < 0.05$) decreased when the piling days of compost increased. The ammonia removal efficiencies of filter A were 94.8% and 93.6% when the GCT was 15 and 23 seconds, respectively, and the rates were significantly higher than that under GCT 11 seconds. The odor removal efficiencies were between 50.6% and 75.6%, and there was no difference among different GCT. There was no difference on ammonia removal efficiencies among different GCT for filter B. The ammonia removal efficiencies were 83.3%, 86.5%, 85.2% under GCT 11, 15 and 25 seconds. There was no difference on the odor concentrations among different GCT and pH. The odor removal rates were 47.2% - 69.4% and 50.4% - 77.0%, when the filter B was operated at different GCT and pH, respectively. According to these results, a bio-trickling filter with GCT 15 s and a trickling filter with pH at 6 were suggested to be utilized on the removal of ammonia and odor produced during the composting process of broiler litter.

*(T. H. Hsiao)*

## The air pollutants scrub facility for pig house

A scrub faiclity was installed on the ventilation system of a close-type pig house. When the vetilative conditions of the system were set up at 0, 40%, 60%, 80% and 100%, the wind velocities were 0.65, 0.79, 0.66 and 0.53 m/s, respectively, lower than those before installization, and the ventlation amount were 198, 242, 200, and162 $m^3$/min , respectively, lower than those before installization. The empty bed retention time (ETRT) were 0.28, 0.32, 0.44 and 0.66 sec while the ventilation system of the pig house were set at 100%, 80% 60% and 40%, respectively. After treatment of this scrub, the removal rate of ammonia, dust, and odor from pig house were 54.2%, 79.2%, and 55.4%, respectively. The ammonia, dust, and odor concentrations of the exhausted gas from pig house were 3.54 ± 2.70 ppm, 0.93 ± 0.30 mg/$m^3$, and 67.2 ± 23.9, which were significantly ($P < 0.01$) higher than those of treated gas, whose concentrations were .57 ± 1.19 ppm, 0.19 ± 0.12 mg/$m^3$ and 34.6 ± 16.5, respectively. The scrub facility in this study could be used to prevent the diffusion of air pollutant for closed-type pig house.

*(T. H. Hsiao)*

## Biogas scrubbing purification system to development and application

Biogas produced from the anaerobic fermentation processes of animal excreta is one of the potential resources of sustainable energy. Biogas contains methane ($CH_4$), carbon dioxide ($CO_2$), traces of hydrogen sulfide ($H_2S$) and fractions of water vapors. $H_2S$ is toxic, hazardous, and extremely corrosive. $CO_2$ reduce heat value of biogas. Therefore, $H_2S$ and $CO_2$ removal is the key point of biogas utilization. The purpose of this study was to develop a high-efficient and low-cost biogas scrubbing purification system to

remove $H_2S$ and $CO_2$ for increasing the purity of biogas from cattle excreta. The biogas passed a scrubbing tower under controlled gas flow rate, water flow rate and water pH, then went through a modular $H_2S$ absorption tower (column packed with ferric oxide). The $H_2S$ and $CO_2$ concentrations of biogas were detected with GC and detectors before and after the treatment. The results indicated that the biogas contains about 60-73% $CH_4$, 30-40% $CO_2$ and 1000-1600 ppm $H_2S$. When retention time of the scrubbing tower was 1 minute, the removal efficiency of $CO_2$ and $H_2S$ were 70-90% and 99%, respectively. When retention time of the absorption tower was 7.2 seconds, the removal efficiency of $H_2S$ was 99%. One kilogram of ferric oxide could absorb 0.16-0.20 kilogram of $H_2S$. The scrubbing and absorption towers developed in this study were very efficient, but the convenience of operating the scrubbing tower needed to be improved. *(M. T. Koh, M. C. Cheng, and M. P. Cheng)*

## Determining the content of nonylphenol in water environment of water fowl farm with GC-MS

Nonylphenol (NP) is an estrogen like compound classified as an endocrine disrupter capable of interfering with the hormonal system of numerous organisms. It originates principally from the degradation of nonylphenol ethoxylates which are widely used in industrial, agricultural, commercial and household applications such as detergents, emulsifiers, wetting and dispersing agents. Due to the extensive use of nonylphenol ethoxulates, they reach either sewage treatment works or rivers and anyway they contaminate environments. Recently, the symptom of azoonspermia occurred to ganders in some domestic goose farms. The syndrome was suspected to be induced by NP polluted in the water environment. Sperms productions recovered, at least partially, after the birds were relocated to a new environment. Most reports dealing with effects of NP on aquaculture animals, few, if any, dealt with those on waterfowls. This study intended to determine the contents of NP in water environment for rasing waterfowls or in commercial detergents by gas chromatography mass (GC-MS) with VF-5MS column. The water samples from waterfowls farms adjusted to pH 3 with HCl were passed through the glass microfiber filters, extracted with GCB solid phase, eluted by dichloromethane/methanol (9:1, v/v) and dried by nitrogen gas evaporation. The minimal detection limit (MDL) of this method was 0.1 ug/L. The NP recoveries through the analytical procedure were 70.5~96.6% and the coefficient of variation (CV) ranging from 2.15 to 5.93% when 1 ug/L standard NP compound was added to water samples. In conclusion, the current method has high reliable stability as well as acceptable repeatability and may be applied to analyze contents of NP in water samples from water fowl farms. *(M. C. Cheng, M. P. Cheng and Y. K. Fan)*

## Effect of nonylphenol on semen quality in breeding Brown Tsaiya

Nonylphenol (NP) is an estrogen like compound classified as an endocrine disrupter capable of interfering with the hormonal system of numerous organisms. It originates principally from the degradation of nonylphenol ethoxylates which are widely used in industrial, agricultural, commercial and household applications such as detergents, emulsifiers, wetting and dispersing agents. Due to the extensive use of nonylphenol ethoxylates, they reach either sewage treatment fields or rivers and contaminate environments anyway. Water fowls are mostly raised with water pools provided in Taiwan. The water coming from either underground or rivers may be contaminated with NP which possibly affects semen quality. Thus, the study was to investigate the effect of nonylphenol on semen quality in male breeding Brown Tsaiya (BBBT). Sixty BBBT at ages of fifty wks were randomly assigned into five treatments, i.e., control, corn oil, oral administration 1 (NP1), 10 (NP10) and 250 (NP250) mg NP dissolved in corn oil/kg body weight daily applied for 28 days. Semen was collected weekly for analyses of counts, viability, acrosome integrity, mitopotential integrity, total cytosolic calcium content and DNA condensation (SCSA) of sperm. Results revealed that there were no significant differences among the treatments in counts, viability, acrosome integrity, mitopotential integrity and total cytosolic calcium content whereas the SCSA in NP10 or NP250 was significantly higher than that in the other group ($P < 0.05$). In conclusion, nonylphenol may affect semen quality of male breeding Brown Tsaiya and consequently reduced its reproductive performance.

*(M. C. Cheng, C. M. Hung, T. Y. Kuo, Y. H. Chen, M. Y. Tsai, M. C. Chan, M. P. Cheng and Y. K. Fan)*

## Effect of temperature and fermentor types on methane production from dairy cattle waste water

The biogas from the anaerobic fermentation of dairy cattle wastewater (DCW) was one of the most potential bioenergy resources. However, the performance of treatment of DCW which contained more fiber was deeply affected by the climate. The purpose of this study was to develope a vertical anaerobic digester (VAD), which was provide the constant temperature with hot water heated by solar or biogas powered heater. The performances of the VAD and a horizontal anaerobic digester (HAD) with the same volume were compared under different conditions. The solid-separated wastewater from a daily farm was conducted to the VAD under 30℃, 40℃ and 50℃, and to the HAD under room temperature in winter and summer. The qualities of wastewater and the composition of biogas were analyzed every 3 day during 15 day's fermentation. The results showed that total amount of biogas produced were 5.41, 6.26, 5.24, 2.64 and 0.59 $m^3$, and the concentration of methane in the biogas were 62.2, 70.6, 64.7, 66.6 and 54.4% in the VAD at 30℃, 40℃, 50℃ and HAD in winter and summer, respectively. In conclusion, the largest amount of methane was produced in the VAD of 40℃ ($P < 0.05$), that was 3 and 6 times of the amount of HAD in summer and winter, respectively. The VAD developed in this study could promote the biogas production, that would help to promote the intention on biogas utilization of the farmer, and achieved the goal of reducing carbon emission and saving energy.

*(M. C. Cheng, T. F. Shiao, M. T. Koh and M. P. Cheng)*

## Study on the effect of environment on the animal welfare of lactating sows and the performance of piglets (I)

The purpose of this study was to investigate the effect of feeding period in farrowing crate on the welfare of lactating sows and the survival rate of piglets. Twenty-four multiparities TLRI black sows were allocated to four treatments, where sows and the piglets were moved to concrete solid free pen (2.1 x 2.1 m) on day 4, day 7 or day 10 until day 21 post parturition. Sows and piglets stayed in farrowing pen throughout the experiment was control group. Behavioural and physiological data of sows and growth performance and survival rate of piglets were collected. The results indicated that the free pen affected the body condition in terms of body weight and back fat thickness of sows. Sows raised in free pen tended to have lower feed intake. The growth performance and survival rate would not affect when sows and piglets moved to free pen on the seventh day post parturition. The physiological response was not different between treatment in exception of the sows raised in crate had lower respiratory rate. Behavioural analysis found sows raised in the farrowing crate changed posture 70 times and the proportion of lying occupied 87% while standing, kneeling and sitting occupied less than 5% within 24 hours. Sows raised in the free pen changed posture 130 times and the proportion of lying and standing occupied 92% and 6%, respectively while kneeling and sitting occupied less than 5% within 24 hours. Therefore, farrowing crate could protect neonate but sows and piglets might be raised in free pen on specific day post parturition to improve sows' welfare.

(*H. F. Lee, B. C. W. Chiou and C. H. Hsieh*)

## Study on the effect of environment on the animal welfare of lactating sows and the performance of piglets (II)

The purpose of this study was to investigate the effect of farrowing crate and slatted floor free pen on the welfare of lactating sows and the survival rate of piglets. Thirty-six multiparities TLRI black sows were allocated to three treatments, where sows and the piglets were moved to slatted floor free pen (2.1 x 2.1 m) on day 4 (D-4) or day 7 (D-7) until day 21 post parturition. Sows and piglets stayed in farrowing pen throughout the experiment was control group (C). Behavioural and physiological data of sows and

growth performance and survival rate of piglets were collected. The results indicated that sows fed in the slatted floor free pen tended to lose more body weight and back fat thickness during test. The growth performance and survival rate of piglets was not affected when sows and piglets moved to the slatted floor free pen on the seventh day post parturition. The physiological responses in terms of respiration rate, body temperature and rectal temperature on D 14 post parturition were not different among treatments. Behavioural analysis from six hours observation found that the sows of C group changed 16 times of postures and the proportion of lying occupied 93%. Sows of D-4 and D-7 group changed 25 and 11 times of postures, respectively and differed significantly ($P < 0.05$) on D 14 post parturition. However, lying occupied the most proportion of time budget for all sows. Therefore, farrowing crate could protect neonate but sows and piglets might be raised in slatted floor free pen on the seventh day post parturition to improve sows' welfare.

(*H. F. Lee, B. C. W. Chiou and C. H. Hsieh*)

## Evaluation of production model of organic livestock (goose)

The organic products including broken rice and soybean plant, and soybean were used in this study for organic geese production. White Roman geese were randomly divided into both control and organic groups with same environment. The result showed that the body weight (BW) and BW gain of the control group had better performance ($P < 0.05$) at 4 weeks of age, because control group had higher crude protein diet (20 vs. 18%). But the performance of both groups had no significant difference at 12 weeks of age, the period from 5 to 12 weeks of age was giving same nutrition level diets. The feed and productive costs were calculated, the cost of organic feed was 3.0-3.6 times higher than non-organic feed. The cost of body weight gain on organic group was 3.2 times higher than non-organic group.

*(C. L. Hu, C. M. Wang, P. C. Nei, Y. S. Chang and Y. S. Jea)*

Organic test geese raising

Conventional of geese raising

## Recycling utilization of waste goose eggs

This study was to investigate the effects of four diet treatments, i.e. 0, 7.69, 15.4 and 22.3 replaced soybean protein content during metabolism period, on growth performance and metabolizable energy. A total of 32 grander, 15 weeks old, were allotted into 32 pens. The metabolizable energy and crude protein of ration used during test period were 2,800 kcal/kg and 15.25%, respectively. The results showed that the protein content of waste egg power product with eggshell or nil were 23.8 and 25.7, respectively. Products cost with eggshell or nil were 8.04 and 10.1NT$/kg.

*(M. J. Lin,* S. C. Chang*, K. C. Wu, Y. S. Cheng and Y. S. Jea)*

Waste egg power product

## Development and application of goose artificial insemination shelf

Geese are seasonal reproductive animal from Oct. to Mar. next year. Geese dividing into individual cage for breeding study are needed. It is also need a lot of labor for the breeding study. The purpose of this study was to develop an artificial insemination shelf to save labor. The result showed that we need only a person for semen collection using the shelf for gander semen collection, but the traditional method three people were needed. The shelf was also tried to use on female geese for artificial insemination. The female geese were also can be fixed well by the shelf. But it still has some problems on the female artificial insemination.

*(C. L. Hu, C. M. Wang, P. C. Nei, Y. S. Chang and Y. S. Jea)*

Use of artificial insemination shelf collected male goose semen

Artificial fixed collected male geese semen

## Recycling utilization of waste water fowl eggs to product liquid fertilizer

The purpose of this study was to make liquid compost of dead germs to promote the added value of the dead germ and reduce the pollution due to the throw away of the dead germ. The dead germs from geese and duck hatched egg were the major stuff adding with minor stuff and fermentation assisting agent. The liquid compost products were made after stable fermentation. Results showed that the nitrogen (N), phosphorus (P) and potassium (K) concentration of liquid compost made from geese dead germs was 6.2, 0.8 and 0.3%, respectively. The N, P and K concentration of liquid compost made from duck dead germs was 6.9, 0.7 and 0.2%, respectively. The N, P and K concentration of liquid compost made of geese dead germs aerated for 18 days was 4.1, 1.1 and 0.3%, respectively. The N, P and K concentration of liquid compost made of geese dead germs aerated for 20 days was 5.6, 1.2 and 0.4%, respectively. The N, P and K concentration of liquid compost made of duck dead germs aerated for 12 days was 7.6, 0.8 and 0.6%, respectively. All the liquid compost products of this experiment were complied with the Miscellaneous Organic Liquid Fertilizer standard (Items No. 5-14). The cucumber was planted to evaluate the effect of the liquid fertilizer products and commercial liquid fertilizer product. Results indicated that the production and chemical composition of cucumber varied among the test liquid compost. In summary, the liquid compost made of dead germs could be a source of crop fertilizer. However, further research is needed for the usage of liquid compost made of dead germs in the future.

*(C. H. Liu)*

## Effect of different chicken house on the egg quality and reproduction performance of LRI native chicken breeder under hot season

The experiment was to compare the egg quality and reproduction performance of LRI native chicken breeder fed under water-pad and open chicken house with individual and group cages during hot season. Two hundred and sixty four day-old LRI Taishu No.12 female chicks were used as experiment animals. After 18 weeks of age, birds were allotted into two groups, one in open breeder house and one in water-pad breeder house feeding with the same laying diets. Egg quality, fertility rate, hatch rate, hatched chicks weight and antibody titers of ND, IB and IBD were recorded during hot season (June-Aug.). In reproduction performance, fertility rate was higher in group cages than that in individual cages of traditional or water-pad house after 1-7 days of AI ($P < 0.05$). No significant difference was found on hatch rate. Water-pad house with group cages had higher hatched chicks' weight than the other groups ($P < 0.05$). No significant difference was found on fertility rate and hatch rate after 8-14 days of AI. In the 1st egg weight, water-pad house with group cages was significantly higher than traditional house with individual cages ($P<0.05$). In antibody titers, water-pad house with group cages was significantly higher than traditional house with group

cages ($P < 0.05$).
(*C. M. Hung, Y. F. Lin, T. F. Chen, H. L. Liu, B. Shih, Y. D. Lin, C. C. Cheng, C. H. Hsieh and Y. S. Cheng*)

## The establishment of supplying system for rabbit with minimum disease

The purpose of this project was to supply high quality experimental rabbit for biomedical purpose. For the convenience of ordering rabbit, reduce labor cost and improve administrative management efficiency, standard operating procedure (SOP) for minimum disease rabbit was implemented. The SOP was setting for feeding management and health monitoring. The SOP also approved with ISO 9001:2008 certified. An on-line purchasing system coupled with document management system has been set up for better service for the user and efficiency for administrative management.
(*M. Y. Tsai, H. H. Wu and C. H. Hsieh* )

## Establishment of goat feeding and management demonstration system

The aim of this project was to introduce the automatic milk measuring and sampling devices and to create software on goat management for the collection of breeding data in nuclear dairy goat farms. Twelve sets of automatic milk sampling devices were imported from Swiss. Meanwhile, four dairy goat farms with 65, 156, 23 and 28 heads of lactating does were selected and assigned as farm A, B, C, D, respectively. Only the dairy does with registration of pedigree were selected for the study. The primary results showed that, milk yield, percentages of fat, protein, lactose, solid non fat and somatic cell counts in milk were 1.97~2.82 kg, 2.80~3.31%, 2.80~3.07%, 4.25~4.52%, 10.91~11.51% and 69~232 x $10^6$/cc, respectively. It revealed that the quality of goat milk was significantly affected by the feeding of different stuffs and the different management styles. Two versions of software for management of dairy goat farm i.e. PDA and web version, were designed and tested. The PDA version of software was easily operated by farmers for collection data in the field. On the contrary, the web version of software was convenient for farmers to upload data to the server located at Heng-Chun Branch, LRI for further calculation of breeding values of dairy or meat goats in the future.
*(S. D. Wang, A. K. Su, C. J. Feng and S. S. Yang)*

Newly imported LactoCorder® milk recorder that performed at private dairy goat farm

## Establishment of goat feeding and management demonstration system

The objectives of this study in 2011 were continuously collecting milking data from dairy farmers for the construction of DHI (Dairy Herd Improvement) and developing an electronical goat-handling system, thus building the goat feeding and management demonstration system gradually. Accumulated data of 3123 dairy goats that based on 250 d milking period from six dairy goat farms were collected, for the purpose of establishing the Alpine and Saanen database of milk yield and milk composition. Six hundred and forty-seven head of goats were registered as the breeding goats. For the respective of constructing electronical milking system, milk sampling bottles with electronical chips and high frequency RFID hoof-rings were developed. Besides, a system that combines goat - handling corral facilities

Developing of milk sampling bottles with electronical chips for the LactoCorder® milk recorder

with ultrahigh RFID electronic ear tags was also established. Based on the tested results we found, 22.4% of working time was saved as compared with the conventional hanging scale weighing process, and weighing stress, cost of labor and handling risks were also reduced.
*(S. D. Wang, A. K. Su, C. J. Feng and S. S. Yang)*

Electronical goat handling system that combines ultrahigh RFID electronic ear tags with auto-weighing scale

## Effects of different feed forage on methane emissions of cattle and goat

The aim of this study was to investigate the volumes of methane emission of cattle or goats by feeding Bermuda hay and Alfalfa hay in two different confinements. The methane emissions from cattle or goats were detected by Open Path $CH_4$ Analyzer for establishing the methane emissions of ruminant. Eight Taiwan yellow cattle or twenty four Taiwan black goats that with the same age and the same body weights, were divided into two groups in different barn, respectively. Each group had duplicative sets, two cattle or six goats in the same set. The animal in one group received Bermuda hay, while another group received a mixture of 50% Bermuda hay and 50% Alfalfa hay. Results showed that per kg of body weight of Taiwan yellow cattle that received Bermuda hay can produce 0.9484 ppb methane, while cattle that received Bermuda and Alfalfa hay produced 0.5768 ppb methane. Another experiment also showed that per kg of body weight of Taiwan black goat can produce 7.7405 ppb of methane, while goats that received Bermuda and Alfalfa hay produced 7.0782 ppb of methane. Evidences showed that methane emissions of ruminants were less when they consumed Alfalfa hay. Meanwhile, goats produced more methane than that of cattle both on Bermuda hay and Alfalfa hay consumption.
(*J. S. Shiu, T. Y. Li, A. K. Su, G. F. Li and J. C. Haung*)

Open Path $CH_4$ Analyzer

## Establishment of models of floor feeding and free-range feeding layer

The purpose of this study was established a model of floor feeding or free-range feeding layer of hens. The growth and layer traits of battery, floor feeding and free-rang feeding models were compared to decide what is the suitable nutrient requirement and feeding methods for layer hens. This know-how and techniques of the floor and free-range feeding model will provide to hen farms. The study was used ISA brown shell layers and they were divided into three models, battery, floor and free-range feeding. The item of investigation was focused on feed nutrient concentrations during laying period. The study were compared the laying traits, egg quality and egg compositions of three feeding models. According to the basal feeding records of three models for the brown laying hens reached production requirement, evidence showed that hens needed 273 kcal metabolizable energy and 17.0 g crude protein per day in the early production period. Meanwhile, hens also needed 3.7gm calcium and 20.0 g crude protein per day in the late production period. On the production period from 45 weeks to 75 weeks of age, the hens on free-range group had no significant

difference on the average egg production, egg weight, egg shell quality, egg shape index and yolk index among those three treatments. However, the hens on free-range group had a highest mortality ratio and the highest outside nest egg ratio among those three treatments.

*(Y. T. Chan and A. K. Su)*

ISA brown egg shell laying hens were feed as free-range raring model

## The development of automatic egg collection equipment and technology for laying ducks

This experiment was aimed to explore the effects of nest box type on egg production rate, floor-laying rate, broken egg rate and eggshell cleanness degree in Brown Tsaiya ducks. The nest boxes tested included metal wire (MW), wood cover with wire floor (WF) and wood cover with artificial turf floor (WA). Two hundred and forty 73-week-old Brown Tsaiya ducks were used. They were raised in a semi-open duck house and randomly assigned to three groups (MW, WF and WA, respectively). There were two replicate pens in each group with 40 ducks in each replicate pen. A bathing container and nipple drinkers were offered in the pen, and at night a 20-candle-light of fluorescent lamp was used. During the experiment feeds and water were under ad libitum. The results showed that the laying rate in each group was associated with the ducks' feed intakes. No differences in egg weight and eggshell strength were observed among groups. Eggs laid on the floor decreased apparently ($P < 0.05$) with increased ducks' ages, with group WF and group WA had lower floor-laying rate than that in the group MW ($P < 0.05$). Regarding to eggshell quality, the nest boxes contributed to reduction of the broken rate, and significantly reduced the microorganisms on the eggshell surface ($P < 0.05$).

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

The automatic duck-egg collection system

## Studies on improvement of productive efficiency in ducks in artificial climate chamber and environment-controlled house system

The aim of experiment 1 was to determine the effects of ambient temperature on production performance and blood traits in Pekin ducks, and to reduce ducks' heat stress by adjusting diet formulation. Ducks were raised in the climate chamber in which the temperature and humidity can be adjusted. The ducks were divided into three treatments; the ducks were given (1) general commercial diet; (2) nutrition concentrated diet and (3) diet with low heat increment. The results showed that different diets did not give rise to the differences in the growth traits, carcass traits, feed intake and cloacal temperature. In

the determination of the blood traits, only chlorine levels in the second and third week after ducks treated were different between the treatments. The results indicated that the formula still left a room for improvement. The aim of experiment 2 was to raise Muscovy ducks in the windowless house to regulate the reproductive performance of Muscovy duck by artificial lighting regime. The results showed the egg laying performance of three groups were similar. The results of fertility showed light-decreasing group had worse performance than the control group, while no differences in hatchability among three groups were observed. Significant differences in eggshell strength were observed when ducks were at 35, 60 and 85 weeks of age, but a fixed pattern was not observed. In egg weight, two light-controlled treatments were significantly higher than control group before 50 weeks of age and the light-decreasing group had heaviest egg weights thereafter. In body weight, ducks in the two light-controlled groups were heavier than control group in the early stage but similar body weights were found in the second laying period. In feed consumption, the light-controlled groups had close results throughout the experiment, and those in three groups were all decreased slowly with increased age and decreased egg laying performance. After ducks were forced moulting, the feed consumption was temporary increased then returned to the same trend of declining gradually.

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

Muscovy ducks exposed to artificial lighting regime in the windowless house

## Application of radio frequency identification in management of breeder duck

The damping fin, been hanged on wire of individual cage and been weighted test, successfully limited the position of egg rotation then not affect the correct egg position identified by auto egg recording system, which means the developed damping fin system was simple but effective for egg identification. For the automatic weighting system accompanied with electronic identification, two persons as a team, can weight 300 ducks per hour with less time and better reliability comparing with traditional one. We also developed the handhold-egg-recording system (equipped with related software, PDA, RFID tag and reader) which recorded duck egg-laying performance with less labor cost and less hardware cost. We also try to develop auto data collective system, with combination between automaitc identification and automatic weighting, to record individual feed intake of animals in group on the floor for further selection on residual feed consumption.

(*H. C. Liu, L. Y. Wei and J. F. Huang*)

The damping fin successfully limited the position of egg rotation.

## Using Radio Frequency Identification (RFID) technology for dairy cattle electronic management and traceability

The Radio Frequency Identification (RFID) technology included RFID electronic ear tags, reader, data wireless transmission, and information network. There were 10 dairy farms using Radio Frequency Identification (RFID) technology for their dairy herd electronic management. The selected RFID electronic ear tag is passive read and UHF sealed by polyurethane material and is hang up at the inner part of right ear of dairy cow. Cow's ID is displayed on exterior of ear tag for herdsman visual identification. The handhold reader with PDA function can read cow's ID from RFID ear tag away over 80 cm distance. The dairy herdsman can use the handhold reader in the barn for looking into the current

performance of the cows and collecting or editing data of dairy cows performance such as calving, breeding, drying, calving, checking pregnancy, disease treatment, high milk yield and high SCC cows… i.e. The dairy herdsman can use the handhold reader for herd batch practices such as vaccine, grouping cows, cows disposal, disease monitor, and body weighting. In milking polar, a fixed reader with 4 sets of antenna is set up. At the entrance of each side, 2 antennas at different location and angle were set up to read ID from RFID ear-tag. When milking cows pass through entrance, the cow's ID, last milk yield, SCC, medical of the cow last time with different color to alert milkers to notice the special cows would be shown on the monitor. The herdsman should improve the practices in time for these special cows. All data of cow's ID and current date would be collected without any hand-writing. The date data would use the system of PDA, After finish collecting data at barn, data would transfer to the farm office computer automatically and all information of DHI would be download from DHI records database through network. Applications of RFID technology on the dairy farm help herdsman collecting data without time-consuming and paper reports, and using information in time with automation, accuracy.

*(C. L. Chang, S. H. Wang and K. H. Lee,)*

## Wireless web based system for dairy farm management

The Wireless Web based System for dairy farm was integrated by Radio-Frequency Identification (RFID), ear tag and reader, handhold data collection device, such as tablet PC and wireless internet access environment. Farm manager can use remote web programs on farm for real-time data audit through RFID reader on handhold device. Data transfer was through wireless broadband router, fast ethernet switches, outdoor omnidirectional antennas or boosters which built the on farm WIFI wireless internet access environment. Remote MS SQL server database is in Livestock Research Institute, Hsin-Chu Branch, Council of Agriculture. Data inquiry is the major service in this phase demonstration. RFID reader reads animal identification to handhold device, and which can inquire associated data from all kind of active web page programs through WIFI network on farm. In next phase, the project will implant data edit or data insert services. The Wireless Web based System environment for dairy cattle can enhance decision information providing, dataflow and management efficient for dairy farmers.

*(K. H. Lee, J. Y. Chen, S. H. Wang, W. J. Chang and C. L. Chang)*

## Application of chilled water for alleviating heat stress in dairy cows

The aim of this study was to evaluate chilled water for alleviating heat stress on cows in lactation. A cross-over design with an experimental period of 28 days and same feeding management was conducted with 8 cows whose milk yield averaged 21.2 kg per day. Eight cows were divided into treatment (n = 4) group and control (n = 4) group. Cows were provided with chilled water (23℃, treatment group) and ambient water (28℃, control group) through drinking and sprinkler. During trial period, the dry matter intake, milk production, milk components and somatic cell count as well as triiodothyronine (T3) and thyroxine (T4) of cows were measured. Respiration rate (at the 2 p.m.) and rectal temperature (at the 8 a.m., 2 p.m. and 8 p.m.) were measured from 4 cows per group. The results showed that the average the dry matter intake, milk production, milk components and somatic cell count of treatment group was not different from control group. Yet we found that treatment group had significant decline in respiration rate (-14.4 ± 3.2 vs. -2.8 ± 2.7 breaths/min , $P < 0.05$) and rectal temperature (-0.22 vs. -0.08℃, $P < 0.05$) than control group. In serum assay, the concentration of T3 and T4 showed no significant difference between treatment group and control group.

(*K. H. Lee, S. Y. Kuo, S. H. Wang, J. Y. Chen, W. W. Lan, C. C. Chiang, F. C. Shiao, J. X. Zhao and C. L. Chang*)

## The mechanism of using Chinese herbal medicine to control the mastitic pathogens

The study was conducted to decrease the high somatic cell count Chinese herb medicine which possessed functions of anti-inflammation, (SCC) and bacterial count in dairy cattle by using Chinese herbs. This anti-fever and analgesia was used and ground as powder form. The dairy cows that SCC and bacterial count (E. coli) in raw milk were over 500,000/ml and 20,000/ml, respectively, were fed concentrate with Chinese herb medicine powder. Trial dairy cattle were divided into two groups. Each cow was fed Chinese herb medicine everyday in treatment group. Each experiment lasted 28 days. At start and end of the experiment, we measured the SCC, bacterial count, fat, protein, and lactose of milk in cows. In vitro, we measured the TNF-α, I L-1β, IL-8, and NO for the supernatant of leucocytes that were LPS (10μg/ml) was added either alone or with various concentrations of herbal extract. The cytokines TNF-α and IL-1β mRNA expression levels by using RT-PCR assay. The aim of our experiments is using Chinese herb medicines to decrease SCC and bacterial count in raw milk and to treat mastitis.

*(K. H. Lee, S. H. Wang, J. Y. Chen, C. C. Chiang, F. C. Shiao, J. X. Zhao and C.L. Chang*)

## The relationship between milking curve and somatic cell count mastitis

According to the season, hot season and cold season is divided into two experimental period. Chose 18 cattles which in peak lactation (2~5 months), and in good health, without hoof disease, breast full of milk cows as the experimental cattle. Use of automatic milking test equipment, measuring individual cattle milk yield and the milking velocity. Collected milk samples to send DHI laboratory testing of milk somatic cell count, as the basis for the occurrence of mastitis. Followed by analysis of correlation between individual cattle milk yield, milk somatic cell count and the milking velocity. Another measured the teat shape of every cattle, including around the perimeter of the teats,the teats length, and the anatomy of the nipple with the teat wall thickness and teat canal length, then analysed the correlation between teat shape, milk somatic cell count and the milking velocity. The results showed that the correlation coefficients among milk yield, milk somatic cell count, and milking velocity are very low. (The correlation coefficient between milk yield and milking velocity is 0.155, the correlation coefficient between milking velocity and milk somatic cell counts is 0.093, the correlation coefficient between milk yield and milk somatic cell counts is -0.144. ) In terms of the correlation among teat shape, milk somatic cell counts, and milking velocity. The correlation coefficient between teat wall thickness and milking velocity is 0.299, the correlation coefficient between teat wall thickness and milk somatic cell counts is 0.348, the correlation coefficient between the perimeter of the teats around and milk somatic cell counts is 0.288. While the other correlation coefficients between traits wrew relatively low.

(*W. J. Chang, C. L. Chang, C. C. Chiang, S. H. Wang, F. C. Hsiao, K. H. Lee and J. S. Chao*)

## Assessment wireless sensor network system in dairy farm and remote management

Exhaustive record dairy cows barn inside and outside environment temperature, relative THI and wind speed and wind direction of the various seasons in dairy farm. Use the cow detection vibration sensory to detective the cows each hour vibration times every day. Accroding to the cows vibration times in before oestrus, being oestrus and after oestrus breeds to statistics the active time at the midnight to early morning period, to make a decision of the best mating times. Use the low temperature sensory to detective the milk tank temperature and control the milk quality change. If milk tank temperature rise to 5℃ above time,the low temperature sensory will through the WSN monitor to warning the farm management to make the emergency treatment.

*(S. H. Wang, K. H. Lee., C. C. Chiang, F. C. Hsiao, W. J. Chang, J. S. Chao and C. L. Chang)*

## The study of monitoring the quality of drinking and cleaning water for cow to improve the efficiency of management in the ranch

This study examines the physical and chemical properties, heavy metals, and microorganism of water in domestic ranches. The physical and chemical properties include pH, electrical conductivity, total dissolved solids (TDS), nitrate-N, nitrite-N, hardness, sulfate and chloride, etc. Heavy metals include iron and copper. The microorganism includes Fecal coliform, *Fecal Streptococcus*, *Escherichia coli*, and standard plate count, etc. The result shows that 467 ranches have higher chemical and physical properties in their groundwater than in their tapped water and processed water except for pH values. Moreover, readings from a few ranches show excess amounts of sulfate, chloride, iron and copper which fail to meet America's NRC (2001) standard, or high content of electrical conductivity, TDS and hardness. Further observations are required to tell if water quality has any causal relations with cow's diarrhea, growth, and milk amount or milk quality. The result also shows huge variations of microorganism readings from the groundwater in 312 ranches. Several ranches have poor groundwater quality. The microorganism readings (n=20) of the trough water (taken from groundwater) are much higher than those originally from the groundwater, indicating that trough water is highly polluted by cow dung. It is necessary to monitor the water quality of unqualified ranches on regular terms and instruct improvement when required.

*(S. J. Lee and C. L. Chang)*

## Study and application of liquid fertilizer transformed from surplus milk by fermentation

This experiment was using surplus milk for fermentation by pump air at fixed time under room temperature. The tendency of pH, conductivity, content of nitrogen, phosphoric anhydride, potassium oxide, calcium oxide and magnesium oxide were the same between centrifuge and non- centrifuge group during storage. The pH decreased steadily, however, conductivity and content of nitrogen were increased remarkable. And variation of phosphoric anhydride, potassium oxide, calcium oxide and magnesium oxide were very small. Change of metals included copper, zinc, cadmium, nickel, chromium and lead were unobvious. Content of nitrogen and total amount of nitrogen, phosphoric anhydride, potassium oxide in non-centrifuge group were superior to those in centrifuge group until third month. The experiment needs to repeat in other seasons.

*(S. J. Lee and C. L. Chang)*

## Establishment of the digital learning system on management of layer farm

The purpose of this study was to combine several computer systems on layer farm developed by Livestock Research Institute, Council of Agriculture, Executive Yuan. They include cost-efficiency analysis spreadsheets, management diagnosis and management knowledge base, and introduced other professional knowledge to build the online digital learning system on management of layer farm. The courses of this system comprise breed, feeding and management, nutrition, epidemic prevention, environmental protection and efficiency evaluation. These courses presented by briefing video and interacting animation, individually. Especially, the flies prevention and self-defense courses are FLASH system that could attract the learner's interest and provide a learning environment not limited by participants, time and location. It assists participants with full of knowledge about management of layer farm, and then promotes poultry industry to reach developing potential. The system has been introduced through the management training program to poultry farmers and therefore expands its extension and application.

*(B. Y. Wang, B. L. Shih, Y. C. Chang and S. W. Roan)*

## The research of the optimal managerial model to promote competitive ability

The study based on the managerially recording accounts (July, 2009 ~ June, 2010) on the 25 dairy farms. There was not great difference of the managerial profits between the southern and middle northern Taiwan. View from the comparison of the farm size, the size 150~199 heads on feeding was the highest managerial efficiency among the 4 farm sizes, because its net revenue and farm earnings per head of dairy cattle and per kg of raw milk were the highest. Next was the farm size 100~149 heads on feeding. If the labor and capital were restricted, the size of 100~149 heads on feeding was more suitable to raise dairy cattles.But it must be enhanced on the pure technical efficiency to offset the fault of the diseconomic size. All the 4 sizes of dairy cattle on feeding, the managerial profits were all positive. The small size of dairy cattle farm can be sustainable mainly based on enhancement on the pure technical efficiency and increasing the production of milking cow. Under the condition of the feed price in the world increased dramatically, it is the best way for the farmer to use domestic forage instead of using imported forage.

*(S. Y. Leu)*

## The survey of the production cost for the dairy goats in Taiwan

This is the first year of the program. Although we gave guidance and assistance about the managerially recording accounts on the 14 dairy goat farms, only 10 farms are efficient samples. Based on the managerially recording accounts (Jan.2010~Sep.2010) for 9 months on the 10 dairy goat farms, the net revenue was about NT$ 1,229,570 per farm for 9 months. The total revenue on dairy goat farms include dairy goats mainly and meat goats. The managerial efficiency on the dairy goat farm at the middle Taiwan was less than that at the southern Taiwan. They must make more effort on the dairy goat farm management in the future.

*(S. Y. Leu)*

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

## The research of the production and marketing model to promote competitive ability

The study was based on the managerially recording accounts (July, 2010~June, 2011) on the 23 dairy cattle farms. The managerial profits on the dairy cattle farms at the middle northern Taiwan were more than those at the southern Taiwan. View from the comparison of the farm size, the size of 150 ~199 heads on feeding was the highest managerial efficiency among the 4 sizes, because its net revenue and farm earnings per head of dairy cattle and per kg of raw milk were the highest. Next was the farm size more than 200 heads on feeding. If the dairy cattle farm didn't plant forage, the production cost per head for one year was more than that on the dairy cattle farm being planted forage about 10.96%. Since from December in 2009, the purchased price of raw milk per kg increased NT$ 1.65 and farmers used more forage corn to substitute for imported grasses, the managerial profits of the 4 sizes on dairy cattle farms were all positive. The small size of the dairy cattle farm can be sustainable mainly based on the enhancement of the pure technical efficiency to offset the fault of the diseconomic size and planting forage to reduce cost. The production cost per kg of raw milk was affected greatly by the milk produced of the lactating cow, the ratio of the milking cow and the feed price. Under the condition of the feed price in the world increased dramatically, it is the best way for the farmer

to use domestic forage instead of using imported forage. Based on the managerially recording accounts (Oct, 2010~Sep, 2011) of the black hair pigs farms fed with table wastes mainly, the production cost per 100 kg for the conventional farms was NT$ 5,280. The main components of the production costs were feed cost (72.61%), labor cost (12.27%), construction and repairment (1.58%), the depreciation of breeding pigs (0.11%). The average weight was about 138 kg per head of the black hair hogs fed with table-wastes for 11 months. The net revenue per 100 kg was about NT$571 under the selling price NT$68.16 per kg. If the farmer didn't raise breeding pigs, the production cost was about NT$ 7,135 per head of the back hair hogs. The main components of the production costs were the purchased cost of piglets (31.26%), feed cost (28.78%), labor cost (19.56%), and the depreciation and repairment of construction (2.86%). The average weight was 141.45kg per head of the black hair hogs fed with table-wastes for 12.5 months. The net revenue was NT$401 per 100 kg of hog under the selling price NT$ 71.48 per kg.

*(S. Y. Leu)*

## The survey of the production cost for the dairy goats in Taiwan and the development of the sofware about the managerial records and the benefit analysis on the dairy goat farms

The study was aimed at to analyze the production cost for the dairy goats in Taiwan. Based on the managerially recording accounts (Oct. 2010 ~ Sep. 2011) of the 10 effective sample on the dairy goat farms in Taiwan, the product cost was NT$ 20,011.88 per head of dairy goat for one year. It included the direct cost NT$ 15,970.3, indirect cost NT$ 3,589.7, land rent and capital interest. The main components of the production cost were feed cost (49.28%), labor cost (24.49%), the depreciation of dairy does (9.09%). The net revenue was NT$4,928.78 per head of dairy goat for one year including the sale of raw milk (65.38%) for the dairy goat, sale of goats, waste of goats, the variation of stock etc. The dairy goat farm raised dairy goats of 365 heads on feeding and meat goat 58 heads on feeding averagely. The ratio of lactating goats was about 54.75%, then they got net revenue NT$ 1,750,000 per farm for one year. If the home labor estimate was excluded, the dairy goat farmers could get farm earnings NT$1,815 thousands. The net cost of the goat milk per kg was NT$ 38.6. Comparison of the different size on the dairy goat farms, the managerial efficiency of the size 200 ~ 400 heads on feeding was higher than that of the size 401 ~ 600 heads on feeding. The managerial efficiency on the dairy goat farm at the southern Taiwan was higher than that at the middle Taiwan, but for the meat goats the results was opposite. Affecting the managerial profits excepting for the production cost and the production of the goat milk, the ratio of the lactating goats was also an important key factor.

*(S. Y. Leu)*

# Forage Crops

## Breeding of new napiergrass lines

The objective of this study was to select the better line in forage yield and quality of napiergrass by interspecific hybridization and testing yield by water logging. The major works were as follows: The agronomic characters forage yield, and the contents of crude protein, acid detergent fiber, neutral detergent fiber and water soluble carbohydrate were determined. It was expected to select the elite lines with high forage yield and quality. In the new line test, the results showed that line 10007 was better than those of new lines for forage yield and fiber quality. The contents of both ADF and NDF of line 9905 were higher than those of control. However, the dry yield was higher than that of control over 70%. Napiergrass cv. TLG3 was more tolerate to waterlogging than the other cultivars.

*(J. B. Lin, T. Z. Li and Y. K. Cheng)*

## Production and utilization of napiergrass cv. TLG3

Napiergrass Taishu cv.TLG 3 is a perennial forage grass with bunch type, erect and dwarf stem. Objectives of this study were to determine the effects of nitrogen sources from chemical and organic fertilizers on forage and silage quality, and animal performance. For energy conservation, it is expected to produce high quality of napiergrass cv.TLG 3 by reducing application of chemical fertilizers. The results showed that the fertilizers could not affect the agronomic characters and forage yield. Both contents of NDF and ADF were lower for the plots applied with chemical and organic fertilizers than those with no fertilizer applied. All the plots applied with fertilizer could be made good quality of silage. To delay harvesting or reduce the application of fertilizer could not affect the plant height of the toppest leaf collar, stem diameter, dry matter percents of both leaf and stem.

*(T. Z. Li, J. B. Lin and Y. K. Cheng)*

## Forage germplasms collection and exchange between Taiwan and Vietnam

Forage germplasms collection and exchange between Taiwan and Vietnam through the exchange and the introduction of forage germplasms between Taiwan and Vietnam, the scientists may select the forage species with high forage yield and quality to grow in both countries, respectively. It may be helpful and beneficial for developing livestock industry in both Taiwan and Vietnam. After discussion between the scientists of both Vietnam and Taiwan during visting Vietnam, suggested that the DNA of forage germplasms from both Taiwan and Vietnam were required to be identified before exchanging.

*(J. B. Lin)*

## Collection and preservation of forage germplasms - collection and estimation of brown mid-rib napiergrass in Taiwan

Sixty-nine samples of brown mid-rib napiergrass (*Pennisetum purpureum*) were collected from 15 different locations in Taiwan. The genetic diversity of these brown mid-rib napiergrass was determined by agronomic characters. The results showed that linkage distance ranged from 0.2 to 9.5 among the sampled plants from 15 locations. With the distance of 2.4 as a group, these napiergrasses could be divided into 6 groups: the 1st group was Taipei, Hsinchu, Hualien, Nantou and Kaohsiung, the 2nd was Taitung, the 3rd was Taoyuan, the 4th was Taichung and Changhua, the 5th was Miaoli and the 6th was Yunlin, Pingtung, Yilan, Chiayi and Tainan. The results can provide the information for breeding new brown mid-rib napiergrass lines.

*(T. Z. Li, J. B. Lin and Y. K. Cheng)*

## Collection and preservation of forage germplasms evaluation and collection of napiergrass germplasms in Taiwan area

Napiergrass (*Pennisetum purpureum*) is one of the most important forage crops in Taiwan. The hybrid seeds of napiergrass spread widely. It causes diverse germplasms of napiergrass in the field. In this experiment, 104 samples of native napier grass germplasms were collected from 15 locations Taiwan. The genetic diversity of thesenapiergrass germplasms were determined by random amplified polymorphic DNA (RAPD) analysis. The results showed that 94.18% ($P < 0.001$) variance within the population was significantly different by analysis of molecular variance (AMOVA). The hereditary-distance ranged from 0.0003 to 0.3 among the 15 locations. With the herediary-distance of 0.03, the 104 napiergrass germplasms could be divided into 7 groups: the 1st group from Taipei and Hsinchu, the 2nd group from Miaoli, the 3rd group from Taoyuan, the 4th group from Taitung and Pingtung, the 5th group from Taichung, Nantou, Hualien, Changhua and Yunlin, the 6th group from Tainan, Chaiyi and Kaohsiung, and the 7th group from Yilan. The correlation coefficient between the genetic distance and the cluster dendrogram was 0.68. The results indicated that napiergrass lines from the 7 groups might be sufficient for further evaluation to select the elite lines within a shorter period.

*(J. B. Lin, T. Z. Li and Y. K. Cheng)*

## New cultivar of Napiergrass Taishugrass No.5

Napiergrass cv. Taishugrass No.5 (TLG5) , 2n = 28, selected from a hybrid population of cv.TLG2 x NBM (Purple napiergrass), was released by Livestock Research Institute, Council of Agriculture, Executive Yuan,Taiwan, R.O.C. in 2011. Napiergrass cv.TLG5 is a perennial forage grass with bunch type and purple leaf and stem, high up to 4 m. It persists for many years if it is managed properly. Its unique characteristic is high anthocyanins content and antioxidant capacity. It adapts to subtropical and tropical areas and prefers to grow in well-drained soils. It can not tolerate with much frost. The purple napiergrass cv.TLG5 without any agrochemicals used in cultivation, with good taste, high anthocyanin content and antioxidant activity. It might be used as a material to prepare safe and healthy food.

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

Napiergrass Taishugrass No.5

## Breeding of nilegrass (Acroceras macrum) elite line

The aim of the strict test was to select the elite line of nilegras with high forage yield and quality for feeding livestock. There were 2 nilegrass lines, i. e., A02 and A10 used and Nilegrass Taishu No.1 (NLT1) as the check variety in 2011.These lines were grown and evaluated at four locations, i.e. Hsinhua and Gueiren in Tainan, Chiayi and Pingtung. The results showed that leaf collar height and plant height of Line A10 were 85 and 112 cm, respectively, and both were similar to those of NLT1. Line A10 had smaller stem diameter with 1.98 mm. The dry matter yield of Line A10 averaged with four locations was 6.34 mt/ha/cut, higher than those of Line A2 and NLT1. It had 25.8% of weed in the field of NLT1, higher than that of Line A10 with 6.3%. The content of crude protein (CP) of Line A10 was 9.8% which significantly higher than that of NLT1 with 8.8%. The contents of acid (ADF) and neutral (NDF) detergent fibers of Line A10 were 36.4 and 64.5% significantly lower than those of NLT1 with 38.3 and 66.5%, respectively. The contents of water soluble carbohydrate and starch for Line A10 were 2.36 and 5.95%, respectively. Besides, the silage quality of both Line A10 and NLT1 were determined 36 days after ensiling in the tank. The crude proteins of silages of Line A10 and NLT1 were 7.81 and 7.45%, respectively. The ADF and NDF of silage of Line A10 were 38.3 and 64.8%, respectively, lower than those of NLT1.

From above results, it indicated that Line A10 had the potential with higher forage yield and quality and could be made good quality of silage for feeding livestocks.
*(S. P. Shaug, S. R. Chang and C. T. Hsu)*

## New cultivar of Nilegrass Taishu No.2

Nilegrass Taishu No.2 selected from an open pollination progenies with female parent AC20 and possible male parent AC26, was released by Livestock Research Institute, Council of Agriculture, Executive Yuan, Taiwan, R.O.C. in 2011. It is a perennial forage grass and adapts to subtropical and tropical areas and prefers to grow in well-drained soils. It has erect, thin stem and more tillers to compete against weeds. Nilegrass Taishu No.2 has high leaf/stem with later maturity. It can be harvested every two months or at plant height with 80~110 cm. It can produce dry matter 30 mt/ha yearly and has high forage quality with crude protein 9~11% and the contents of acid and neutral detergent fibers 33~38% and 63~68%, respectively. It is recommended to farmers to grow as green chop or making hay or silage to feed livestock.
*(S. P. Shaug, S. R. Chang and C. T. Hsu)*

Nilegrass Taishu No.2 grown in the field

## Contents of heavy metals Cd and Pb in the soil of pasture in Taiwan

Objectives of this study were to determine the contents of Cd and Pb in the soil of major areas for forage production in Taiwan. The soil samples were taken for analysis from the pastures in Changhua, Yunlin, Chiayi, Tainan, Kaoshiung, Pingtung, Taitung and Hwalien. The results showed that the contents of Pb ranged from 1.62 mg/kg to 8.60 mg/kg with averaged 4.75 mg/kg. It was the 3$^{rd}$ level of the standard contents for the heavy metals in soil of Taiwan. It was considered in the range of the background contents of heavy metals in soil under Taiwan environment. The contents of Cd in pasture soil were in the 2$^{nd}$ level (< 0.05 mg/kg) or in the 3$^{rd}$ level (0.05-0.39 mg/kg) of standard contents of heavy metals in soil of Taiwan. It was less than the contents of the background levels or in the range of the background level of heavy metals in soil under Taiwan environment. It showed that the soil of the pasture was not contaminated with heavy metals Pb and Cd in Taiwan.
*(F. H. Hsu and C. H. Lu)*

## Energy consumption for the production of pangolagrass hay

Pangolagrass (*Digitaria decumbens*) is the major forage species for making hay in Taiwan. The energy consumption for the production of pangolagrass hay contains the mechanic operation for hay making and fertilizer application. The mechanic operation for hay making includes cutting, tedding, windrowing, baling, relying on and transporting. The tedding consumed the most energy with 44.6% among the mechanic operation for hay making, followed by cutting with 26.4%. It consumed the diesel fuel 5.28 L and produced $CO_2$ 13.79 kg for producing pangolagrass hay 1 mt. The annual amount of fertilizers applied for pangolagrass were N 460, $P_2O_5$ 150 and $K_2O$ 300 kg/ha, respectively. The amounts of $CO_2$ production were 1,729, 126 and 199 kg for N, P and K fertilizer application, respectively. The averaged yield of pangolagrass hay was about 24 mt/ha yearly. It produced about $CO_2$ 2,384 kg yearly. The application of N fertilizer for producing $CO_2$ was the highest with 72.5%. It was very important to reduce the N fertilizer application for pangolagrass production. It might be helpful to decrease in energy consumption and $CO_2$ emission.
*(F. H. Hsu, C. H. Lu and J. B. Lin)*

## The carbon depletion and accumulation for the production of domestic forage crops

The objectives of this study were to determine the carbon accumulation and depletion for the forage

production of domestic forage crops. The averaged contents of organic C were 40.1, 41.0 and 41.8% and domestic total yields of organic C were 6.0-9.6、6.2-9.8 and 15.4-18.8 mt $ha^{-1}$ $year^{-1}$ for pangolagrass, napiergrass and nilegrass, respectively. The results of different cutting stages of napiergrass and pangolgrass showed that organic carbon content in plant tissue increased with growth stage advanced. However, the total organic carbon yields of forage were the highest cut at 8-10 week stages. The soil C contents in pastures were various because of different soil properties and management methods. The contents of soil C were 0.60-1.53%, 0.85-3.60%, 0.91-1.38% and 1.05-3.61% for the pasture of pangolagrass, napiergrass, nilegrass and forage maize, respectively. The results showed that the energy of 43,919 MJ $ha^{-1}$ was needed and the amounts of 2,379 kg $CO_2$ were released for producing pangolagrass hay 24 mt $ha^{-1}$ yearly. Nitrogen fertilizer applied was the most source of $CO_2$ released for producing pangolagrass. It was about 72.5% of all the $CO_2$ released. It was suggested that decreasing in the N fertilizer applied might be helpful for conserving energy and reducing carbon emission for pangolagrass production.

(*C. H. Lu and F. H. Hsu*)

## Establishment of the production model for annual short-term forage crops

Objectives of this study were to evaluate the rotation-cropping of forage corn and sorghum with manure crops such as sesbania (Sesbania roxburghii) or Egyptain clover (Trifolium alexandrinum) to establish the whole-year efficient production models for growing short-term forage crops. The results of the first and second years showed that there was obvious change observed on soil characters, especially pH and contents of organic matter after rotation-cropping. The effects of rotation with manure crops on forage yield was also obviously observed. It is necessary to complete the experiment of the third year for further evaluation of the rotation cropping to establish the whole-year efficient production models of short-term forage crops.

(*S. R. Chang, C. H. Lu and F. H. Hsu)*

## Plant regeneration from cell suspension culture of nilegrass

The objective of this study was to develop an efficient plant regeneration system from cell suspension culture of nilegrass (*Acroceras macrum* Stapf cv. Taishu No.1). The callus used for cell suspension culture was induced from immature inflorescences cultured on MS medium with 2.0 mg $L^{-1}$ 2,4-D and 0.5 mg $L^{-1}$ BA for 5 weeks. For establishing and maintaining the suspension culture system, the callus was cut into small pieces and sub-cultured on MS liquid medium with 1.0 mg $L^{-1}$ 2, 4-D and 50 mg $L^{-1}$ casein hydrolysate every 2 weeks for 3 months. When the cell clumps were proliferated, they were transfered to MS solid medium with 2.0 mg $L^{-1}$ 2,4-D and 0.5 mg $L^{-1}$ BA for inducing white and compact callus that was beneficial for shoot regeneration. Plant regeneration from callus was cultured on MS medium with 1.0 mg $L^{-1}$ BA and then sub-cultured on MS medium with 0.5 mg $L^{-1}$ NAA and 0.05 mg $L^{-1}$ TDZ. The frequency of plant regeneration increased from 4.7% to 75% and plantlet growth normally the in field. A culture system for plant regeneration from cell suspension culture of nilegrass was successfully established. It might be useful for germplasm preservation of nilegrass in the future.

*(Y. M. Shy)*

## A study of organic forage production: comparison of four intercropping-systems of perennial legumes with forage corn

The purpose of this study was to investigate the feasibility of incorporation of perennial legumes in organic forage corn production. Four cropping combinations were conducted in this study, which were rhizoma peanut (*Arachis glabrata* Benth), perennial soybean (*Neonotonia wightii)*, alfalfa (*Medicago sativa)*, and perennial peanut (*A. pintoi* Krap. & Greg.) intercropped with forage corn, respectively, to estimate the effects of different legumes on yield and quality of green chop and silage of the mixture with no fertilizer

application. The biomass percent of forage corn, legume and weed were significantly different among combinations. The perennial peanut system produced the highest forage yield of mixture and forage corn, followed by rhizoma peanut system. The forage corn yield in perennial peanut and rhizome peanut intercropping systems were 37.3 mt/ha and 32.8 mt/ha respectively, which went up to 46.8 mt/ha and 33.4 mt/ha on adding the legume yield. The forage corn yields were significantly decreased in perennial soybean and alfalfa systems, which were only 31% and 42% of perennial peanut system. However, mixture of these two harvests contained high levels of legume. Beside the yield, forage quality of these four intercropping system were substantially different, too. Total protein yields of perennial peanut, rhizoma peanut, soybean and alfalfa treatment were 1682.2, 1115.4, 1175.6 and 1032 kg N/ha, respectively. The mixture harvested from perennial peanut and rhizoma peanut systems could be made good silage, while those harvested from perennial soybean and alfalfa systems were not suitable for ensiling. Inoculation of Lactobacillus could reduce the butyric acid content and increase the dry matter recovery of silage, although the quality of silage was not improved significantly. Our results indicated that perennial peanut and rhizome peanut could intercrop with forage corn to establish a fertilizer limited and low-input organic production system. The harvest mixture of these two systems could be utilized either as green chop or silage.

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

## Production system with low input for mixed planting between Digitaria spp. and Arachis spp.

Mixed planting of pangolagrass (*Digitaria decumbens*, A254) and or Survenola (*D. X umiforia*) with *Arachis grabrata* or *A. pintoi* were evaluated to investigate their feasibility in sustainable pasture or low-input production of organic pasture. *A. grabrata* had good persistence in the mixture, however, the initial growth rate was slow. The dry matter yield and the coverage ratio of *A. glabrata* in the mixture increased each year. Mixture of *A. grabrata* and pangolagrass was better than that of *A. grabrata* and Survenola. Dry matter yield of the mixture still maintained 16-19 mt/ha in the third year, while that of the monoculture, reduced to 7 mt/ha. The results indicated that both forage yield and quality could be improved in grass-legume mixture as compared to those in monoculture. When the harvest stage was prolonged to 90 days in summer, the mixtures had CP 9.4%, NDF 61%, and ADF 43%, respectively, which showed relatively high quality as compared to those of tropic forages. The higher contents of nutrient in the mixture were due to higher CP and lower NDF contents of legume. Moreover, slow growth of grass also helped maintaining its forage quality. Large quantity of minerals was removed by the soil by cropping. For example, in the third year a total of 217-277 kg/ha of nitrogen was removed from the above ground part of the mixture. Under biological nitrogen fixation of the legume only, there was no fertilizer input or grazing in this system, and as a result, soil organic matter, total nitrogen, and other components declined in the plots with high productivity. It was concluded that mixed planting between *A. grabrata* and pangolagrass could form a stable grass-legume mixture for organic forage production. It is suggested that grazing or some quantity of compost is necessary to maintain the nutrient equilibrium of the cropping system in the long term.

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

## Production system with low input for mixed planting betweem *Digitaria* spp. with Alfalfa

Mixed planting of pangolagrass (*Digitaria decumbens*, A254) or Survenola (*D. X umiforia*) with alfalfa were evaluated to investigate their feasibility in sustainable pasture or low-input management of organic pasture. After sowing in the autumn, alfalfa showed a substantial yield in the first spring and had a well seasonal compensation with *Digitaria*. The dry matter yields of mixture and monoculture were 22-27 mt/ha and 14 mt/ha, respectively, in trials of pangolagrass in the first year, and were 26-27 mt/ha and 14 mt/ha, respectively, in trials of Survenola. The yields decreased in the second year. However, yields of

mixture were still about two folds to monoculture. Application of compost increased the yield of pangolagrass mixture but had no significant effect on monoculture. The biomass ratios of alfalfa in the mixture were up to 60-70% in February to June, and the lowest ratio appeared in October. The regrowth rates decreased dramatically after the second rainy season. When the harvest stage was prolonged in summer, the yield of grass increased but ratio of alfalfa decreased. The higher CP and lower NDF contents of alfalfa increased the nutritional contents of the mixture. The nitrogen fixed through air not only supplied the growth of alfalfa but also raised the yield and CP content of grass in mixture. It was estimated that 270-469 kg/ha per year of nitrogen were removed by the above ground part of the mixture, but only part of the treatments showed slight declines in soil organic matter and no reduction in soil nitrogen could be observed. It was concluded that sowing the alfalfa as bio-fertilizer in pangolagrass pasture could lessen the need of exogenous fertilizer and improved the forage production and quality at the same time. However, the mixture of grass with alfalfa needed more intensive management as compared to that rhizoma peanut.

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

## The nitrogen yields and seasonal variations of forage legumes and green manure crops

Legume species are indispensable in low-input systems of agricultural production, due to the nitrogen fixation to enhance the nitrogen pool in soil and reduce the dependence on chemical nitrogen fertilizers. The purpose of this study was to evaluate the potential of legume species for low-input forage production. Six species of perennial legumes, alfalfa (*Medicago sativa*), perennial peanut (*Arachis pintoi*), rhizome peanut (*A. grabrata*), perennial soybean (*Neonotonia wightii*), siratro (*Macroptilium atropurpureus*), stylo (*Stylosanthes gracili*), and four species of annual legumes, soybean (*Glycine max*), sesbania (*Sesbania sesban*), mung bean (*Vigna radiata*) and sunn hemp (*Crotalaria juncea*) were used to assess the performance and nitrogen yield in a whole year. The legume species were planted in the pots and were harvested every three months. The results showed that the dry matter yields of above-ground parts of perennial soybean, sesbania and sunn hemp were the highest and those of stylo, mung bean and perennial peanut were the lowest. Different legumes had specific season adaption. The nitrogen content of alfalfa was the highest among all the legume species. The averaged contents of nitrogen for above-ground and under-ground parts of alfalfa were 3% and 2.4%, respectively. The nitrogen yield of above-ground part was consistent with the biomass of the above-ground part. The average yield of nitrogen for entry legumes ranged from 112 to 281 kg/ha/harvest. However, the nitrogen yields in under-ground part of alfalfa (84 kg/ha/harvest) and rhizoma peanut (43 kg/ha/harvest) were obviously higher than those of the others (5 kg/ha-30 kg/ha). The results showed that, all the entry legumes adapted had high nitrogen production and could be helpful for the low-input forage production. Although the perennial forage legumes were not conventionally used as green manure, their nitrogen yields were comparable to those of the traditional green manure crops. Except forage use, the forage legumes can also play multiple functions for improving soil fertility, reducing nitrogen application and promoting ecological balance.

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

## Application of near-infrared spectroscopy on forage analysis

Near-infrared spectroscopy (NIRs) analysis offered the promise of rapid, low-cost analysis of nutrient composition that could be applied to the increasing need for efficiency in livestock feeding. Using this technology, the rapid methods of forage analysis for the major forages in Taiwan have been established. The $R^2$ of calibration equation of the NIRs for crude protein (CP), neutral-detergent fiber (NDF), acid-detergent fiber (ADF), and water soluble carbohydrate (WSC) of pangolagrass were 0.98, 0.85, 0.81, and 0.93, respectively. The $R^2$ of the NIRs regressions for CP, NDF, ADF, and WSC of napiergrass were 0.99, 0.95, 0.98, and 0.99, respectively. The $R^2$ of NDF, ADF, CP, WSC and starch of forage corn were 0.91, 0.96, 092, 0.98, and 0.89, respectively. In virtue of the NIRs analysis, the goals of precise ration preparation, monitoring nutrient conditions and trading forage by quality can be achieved more easily.

*(C. S. Chen* and *S. M. Wang)*

## Quality changes in tropic forage

Forage quality varies with species, maturity and environmental conditions. Due to the flexible cutting intervals, forage quality can be even more fluctuated compared to crops harvested at fixed maturity. Modeling studies of quality changes of Taiwan's major forages including pangolagrass, napiergrass and forage corn are summarized in this article. By combining effects of herbage growing period and temperature, accumulated temperature can be used to predict dry matter digestibility of pangolagrass and napiergrass accurately. Seasonal climatic changes had greater effect on IVTD of pangolagrass than did the cutting intervals. In contrast, IVTD of napiergrass was mainly affected by harvest interval. In forage corn, NDF, ADF, digestibility of NDF, and starch were more affected by harvest time, while CP and IVTD were obviously affected by planting date.

*(S. M. Wang and C. S. Chen)*

# Research Projects in Progress

## Animal Breeding and Genetics

1. Food Animal Breeding Research Consortium (FABRC): selection of new breed of pig - Taiwan Duroc.
2. Food Animal Breeding Research Consortium (FABRC): Selection of the suitable goat breeds on the local environment.
3. Food Animal Breeding Research Consortium (FABRC): Study on dairy breeding farms operation model and breeding cattle supplying system.
4. Food Animal Breeding Research Consortium (FABRC): Establishment of reproduction system in Formosan sambar.
5. Food Animal Breeding Research Consortium (FABRC): Trait selection and application of high feed efficiency in Brown Tsaiya ducks.
6. Food Animal Breeding Research Consortium (FABRC): Selection for high egg production line in White Roman goose.
7. Food Animal Breeding Research Consortium (FABRC): Selection of meat quality and high egg productive breeds of native chicken.
8. Integrated technologies for breeding stock production in animal industry.
9. Food Animal Breeding Research Consortium (FABRC): The commercial production model of poultry breeding eggs.
10. Food Animal Breeding Research Consortium (FABRC): Value improvement of health population and semen and embryo of animal industry in biological safety net.
11. Food Animal Breeding Research Consortium (FABRC): DNA barcoding for pedigreed and registered farm animals.
12. Germplasm management and genetic diversity maintenance of Lanyu breeds of pigs.
13. Genetic analysis for heterozygosity in conserved populations of duck.
14. Maintenance and management of genetic resources in Taiwan Yellow cattle and Taiwan Black goat.
15. Germplasm management and genetic diversity maintenance in LRI native chicken populations.
16. Conservation and genetic diversity maintenance in geese.
17. Assessment of introduction of meat black-goat as reproduction breeder in Peng-Hu.
18. Management of gene banking for animal genetic resources.
19. Collaborative development and exchange in identification technologies of livestock germplasm between Taiwan and Vietnam.

## Animal Nutrition

1. Studies to develop diverse feedstuff resources and diets for livestock in accordance to the global climate change.
2. The application of silage in the feed of KHAPS black pigs.
3. Evaluation of the effect of β-glucan on the reproductive performance of sow and survival rate of piglet.
4. Application of gel-carried nutritional diet to elevate growth performance and immune capacity and survival rate of piglet.
5. Using agricultural by-product on domestic geese diet.
6. Application of by-products for feed resources.
7. Determination of multi-mycotoxin in feeds by liquid chromatography tandem mass spectrometry.
8. Technical development of biofuel material- Effect of green feed on the pork quality and productive performance.

## Animal Physiology

1. The industrialization plan of the fictitious platform of molecule farm—The estimate bio-safety of transgenic got and evaluate production of IgY primary products.
2. Embryo production from superovulated Holstein cattle following insemination of sexed sperm.
3. Food Animal Breeding Research Consortium (FABRC): Sexing semen reproduction system.
4. Food Animal Breeding Research Consortium (FABRC): Commercial production of frozen semen and embryos.
5. Goat dental stem cell for tissue engineering.
6. Establish the technology of goat semen vitrification and low dose insemination.
7. Modification funtioned by chTERT in feeder layer cells of PGC.
8. Study on the immune rejection of porcine embryonic stem cells transplantation.

9. Analysis of pluripotent gene of the chicken primordial germ cells in different culture stage.
10. The effects of Sonic hedgehog (Shh) to goat oocyte maturation and early embryo development.
11. Development of a bipartite doxycyclineinducible vector system for transgene expression and gene knockdown.
12. Effect of probiotics on insulin resistance(I): Screening of probiotics on the ability of inflammatory response and intestinal repair improvement.
13. The study of Insulin-like Growth Factor 1 (IGF1) gene on goat.
14. Study on the management and bio-safety technique of molecular farm.
15. Industrial application of goat reproduction technology.

## Processing of Animal Product

1. The study on reasons of reduced Pidan yield rate in summer season.
2. Development of high quality and exquisite animal products with the feature materials.
3. The investigation and analysis of goat milk in Taiwan and detection of reconstituted goat milk in raw goat milk.
4. Development of ready-to-eat collagen products from poultry by-products.
5. Development of semi-solid meat and dairy products for leisure life.
6. The purification of poultry oil and development of it's product.
7. Production of Kefir cheese.
8. Study on the utilization of salted duck egg white.
9. Development of the diverse goat meat products in Peng-Hu.
10. Develpoment of functional animal product.

## Livestock Management

1. Low-dose insemination in pigs-used low dose cryopreservation semen.
2. Detection and application of semen quality in breeding pigs and roosters by flow cytometer.
3. Assessment of organic beef production and quality.
4. The development of organic rearing regimen for Taiwan buffalo.
5. The utilization of the crossbred meat goat.
6. Establishment of a energy-saving cooling mode for Holstein milking cows by cow comfort index.
7. The study of reducing labor input and waste output on rabbit production.
8. The mechanism of using Chinese herbal medicine to control pathogens of mastitis.
9. Study on risking factors of production life for DHI.
10. To estimate the cold-stored Muscovy duck semen used in the production of mule ducks.
11. Investigation of the optimal indoor duck feeding conditions.
12. Establishment of models of floor feeding and free-range feeding layer.
13. Selection of female white silky chicken for egg production performance.
14. Effect of time span from hatch to farm on the growth performance of chickens.
15. Development and application of goose artificial insemination shelf.
16. The model of range free geese production.
17. Promoting the quality and quantity of geese down.
18. Producing refuse derived fuels from cow dung residues.
19. Effects of floor types on the water consumption and waste-water quantity of pig house.
20. Distribution of antibiotics and its resistant gene in livestock waste.
21. Effect of disinfectant on the treatment efficiency of wastewater field.
22. Study and application of liquid fertilizer transform from waste milk by fermentation.
23. Effects of estrogen like of endocrine disrupter substance on reproduction performance.
24. Energy conservation team-study on the energy and liquid fertilizer production from animal excreta.
25. The team of energy conservation and carbon reduction – Evaluation on the energy control strategy for different livestock building.
26. Reduction of greenhouse gas from livestock excreta treatment.
27. Application of energy-saving equipment in poultry feeding model.
28. Studies on the livestock in vivo green house gas emission and reduction strategies.
29. Study on the effect of environment on the animal welfare of lactation sows and the performance of piglets.

30. Improvement on production of minimal disease minipig.
31. Improving the quality of minimal disease Muscovy duck herd for biomedical purposes.
32. The enhanced of supplying and quality improvement for rabbit with minimum disease.
33. Reinforcement of production and quality of minimal disease breeding geese.
34. Representative meeting to 38th ICAR session and sub-committees.
35. Feasibility assessment of duck breeders exported to Vietnam and strengthening of Taiwan-Vietnam scientific and technological cooperation in duck raising.
36. Establishment of the linear appraisal technique on the body shape of dairy goat.
37. Study on techniques of biogas utilization and sludge treatment of dairy manure.
38. Technical exchange of reinforced electronic management and real-time milk quality control on milking line for dairy farms.
39. The investigation of the production cost for the dairy goat in Taiwan and development of the software about the managerial records and the benefit analysis on the dairy goat farms.
40. The study of the production and marketing model to promote competitive ability of livestock.
41. The study on the professional training needs for livestock farmers - The case study for the farmers of agriculture (livestock) vocational training program.
42. Study on the consumer behavior of consumption for livestock products.
43. Studies of livestock research technology commercialize.
44. The operation of innovation incubator and the promotion of the academic industry exchange platform.
45. The development of automatic egg collection equipment and technology for laying ducks.
46. Quality assurance and improvement system for boar semen in low temperature.
47. Using ICT technology in dairy farm for precise management.
48. Online system for inquiring digital performance information management of Holstein dairy cows (SDIC).
49. Livestock production information management system – The establishment of HACCP system specifications of layer farm.
50. Assessment wireless sensor network system in dairy farm and remote management.
51. Establishment of the feeding and management system on goat production - Development of body shape automatically measuring system and cooling system of goat barn.
52. A study of RFID on production and management of breed geese.

## Forage Crops

1. Breeding of forage corn.
2. Breeding of nilegrass (Acroceras macrum) elite line.
3. Establishment of the production model for annual short-term forage crops.
4. Study on renovation of perennial pasture.
5. Quick determination of soil organic carbon and nitrogen in pasture with near infrared reflectance spectroscopy.
6. Breeding of new napiergrass lines.
7. Production and utilization of napiergrass cv. TLG3.
8. Development of a energy saving and low carbon emission drying system for hay production.
9. The carbon depletion and accumulation for the production of domestic forage crops.
10. In vitro culture of forage crop for germplasm preservation.
11. Collection and preservation of forage germplasm - collection and estimation of brown mid-rib napiergrass in Taiwan.
12. Establishment of information management system on production of domestic forage crops.

# Technical Service

## Journal of Taiwan Livestock Research VOL. 43 No. 1 March 2010

Application of artificial insemination for improving the pregnancy rate of water buffalo (*Bubalus bubalis*) in Taiwan
*Liang-Yuan Wei, Bing-Tsan Liu, Yu-Shine Jea and Cheng-Yung Lin*

Effect of synchronization treatments on the improvement of conception rate for Holstein cows in hot season
*Der-Wei Yang, Tzong-Faa Shiao, Jin-Shan Hwang, Chih-Hua Wang and Bing-Tsan Liu*

Study on thawing extenders for boar frozen semen
*Chia-Chieh Chang and Sheng-Yang Wu*

Telomere length analysis of cloned dairy goat produced by somatic cell nuclear transfer
*Jen-Wen Shiau, Lee-Ching Tsa, Chun-Chin Wang, Yu-Hsin Chen, Feng-Hsiang Chu, Jenn-Fa Liou, Jan-Chi Huang, Cheng- Yong Lin, Chein Tai and Lih-Ren Chen*

Cloning and sequencing of ovalbumin gene promoter sequences from Taiwan native chickens
*Jenn-Fa Liou, Pei-Hwa Wang, Lee-Ching Tsai, Chun-Chin Wang, Cheng-Yong Lin, Chein Tai, Lih-Ren Chen and Jen-Wen Shiau*

The effects of stocking density on the growth performance of growing geese raised in aslat floor house
*Yen-Chih Chang, Chin-Meng Wang, Pi-Chu Nien, Chien-Lung Hu and Yu-Shine Jea*

Genetic relationship of napiergrass determined by ISSR marker
*Dong-Hong Wu and Yu-Kuei Cheng*

Evaluating the application of the native organic forage diet for growing male New Zealand White rabbits
*Hsi-Hsun Wu, Wei-Ling Kho, Ming-Yang Tsai, Chao-Hsien Hsieh and Bor-Chun Weng*

## Journal of Taiwan Livestock Research VOL. 43 No. 2 June 2010

Effect of different feeding regimens on the reproductive performance of female Taiwan country chicken breeders
*Cheng-Yung Lin and A-Li Hsu*

Effects of various protein sources in creep feed on digestive tract protein enzymes development of piglets weaned at 18 days of age
*Chih-Chang Hsiao, Yu-Shine Jea and Der-Fang Jan*

Effect of dietary copper sources and levels on growth, carcass and fecal copper excretions in growing-finishing pigs
*Tein-Ming Su, Herng-Fu Lee, Ting-Hsun Hsiao, Shine-Ming Liou, Kuo-Lung Chen, Jin-Jen Lu and Chung-Wen Liao*

Effects of various protein sources in creep feed on small intestine development and on growth of piglets weaned at 18 days of ages
*Chih-Chang Hsiao, Yu-Shine Jea and Der-Fang Jan*

Determination of cepharosporins in milk by liquid chromatography tandem mass spectrometry
*Ming-Chih Teng and Mian-Lian Lee*

A study of organic forage production: comparison of four intercropping-systems of perennial legumes with forage corn
*Shu-Min Wang, Chia-Sheng Chen, Tsui-Huang Yu and Hsin-Hung Liu*

Production system with low input for mixed planting between Digitaria spp. and Arachis spp
*Chia-Sheng Chen, Shu-Min Wang, Tsui-Huang Yu and Hsin-Hung Liu*

Production of egg yolk immunoglobulin against Escherichia coli from white Leghorn and Lohmann layer
*Jenn-Fa Liou, Yi-Fan Lin, Tu-Fa Lien, Jen-Wen Shiau, Jui-Jane Tailiu, Chein Tai and Lih-Ren Chen*

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Selection of Boer hybrid with goats black coat
*An-Kuo Su, Shen-Shyuan Yan, Ruey-Chuen Hsieh, Yu-Kuei Cheng and Jan-Chi Huang*

Effects of dietary propolis extract supplementation on growth performance and morphology of intestinal villi in Mule ducks
*Jung-Hsin Lin, Chin-Hui Su, Jeng-Fang Huang, Shuen-Rong Lee, Bor-Ling Shih and Tai-Chuan Ho*

The selection of prolific black pigs：Ⅱ. The performance of KHAPS black pigs in field test
*Chin-Bin Hsu, Hsien-Juang Huang, Yen-Jung Chan, Chih-Hua Wang, Neim-Tsu Yen, Chia-Hsuan Chen, Ming-Che Wu, Hsiu-Luan Chang and Yu-Sung Cheng*

Effects of dietary supplementation of propolis extract on growth performance and carcass traits of Pekin ducks
*Chin-Hui Su, Jeng-Fang Huang, Jung-Hsin Lin, Tai-Chuan Ho, Wen-Chi Lee, Bor-Ling Shih and Shuen-Rong Lee*

Investigation on the feces and urine excretion of lactating sows
*Chung-Wen Liao, Tein-Ming Su, Wen-Sheng Jeng, Herng-Fu Lee, Mian-Lian Lee and Meng-Der Koh*

Establishing an organic chevon production system in Taiwan
*Shen-Shyuan Yang and An-Kuo Su*

Removal of odour in composting plant by biofiltration
*Mei-Ping Cheng, Ren-Bao Liaw and Ting-Shun Hsiao*

Differences in heat behavior and ovulation time between Holstein heifers and cows during hot season in Taiwan
*Der-Wei Yang, Tzong-Faa Shiao, Jin-Shan Hwang, Shin-Shing Tsay, Chao-Hsien Hsieh, Chih-Hua Wang, Kuen-Jaw Chen and Bing-Tsan Liu*

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Effects of different ambient temperatures on the reproductive performance and nitrogen and energy digestibilities of lactating sows
*Chung-Wen Liao, Ho-Fen Hsiao, Tsui-Ching Yang and Herng-Fu Lee*

Development and outlook of grassland farming in Taiwan
*Fu-Hsing Hsu*

Effect of slaughter age on plasma and carcass traits in caponized Taiwan native chickens
*Cheng-Yung Lin, Deng-Cheng Liu and Jenn-Chung Hsu*

Effects of extenders on the quality and fertility of cooled Formosan sambar stag semen
*Chih-Hua Wang, Hsin- Hung Lin, Shann-Ren Kang, Ching-Yun Kuo, Wen-Lin Song Chin-Hui Tseng, Mu-Jung Cheng, Bing-Tsan Liu and Perng-Chih Shen*

The viability and subsequent developmental competence of in vitro- matured caprine oocytes vitrified in solutions with various cryoprotectant formulae and equilibrium time
*De-Chi Wang, Hsin- Hung Lin, Ting-Chieh Kang and Jan-Chi Huang*

The nitrogen yields and seasonal variations of forage legumes and green manure crops
*Shu-Min Wang, Chia-Sheng Chen, Tsui-Huang Yu and Hsin-Hung Liu*

Research on the organic dry mulberry leaves in organic goat production system
*Shen-Shyuan Yang, An-Kuo Su and Sheng-Der Wang*

Quantities of goat feces and urine excreted, and their chemical elements
*Shen-Shyuan Yang, An-Kuo Su, Yu-I Lai and Sheng-Der Wang*

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Studies of the Lanyu pig, Mitsae pig and LYD commercial pig on meat quality traits
*Kuen-Jaw Chen, Kun-Cheng Li, Liang-Chu an Lin, Der-Fang Jan, Hsien-PinChu and Chun-Ta Chang*

Effects of surgical caponization on blood characteristics of male Taiwan country chickens
*Cheng-Yung Lin and Jenn-Chung Hsu*

Production system with low input for mixed planting betweem Digitaria spp. with Alfalfa
*Chia-Sheng Chen, Shu-Min Wang, Tsui-Huang Yu and Hsin-Hung Liu*

Studies on the intake and blood biochemical parameters of organically produced does in confinement or grazing system
*Shen-Shyuan Yang Sheng-Der Wang and An-Kuo Su*

Evaluation of the feeding model for organic meat-type native chicken
*Yih-Fwu Lin, Hsiao-lung Liu, Che-Ming Hung, Chao-Hsien Hsieh, Ming-Yang Tsai and Chu-Chun Cheng*

Study on colorful broiler slaughterhouse wastewater treatment by activated sludge
*Tying-Siyun Hsiao, Tyan- Mying Su, Meng-Te Koh, Yu-I Huang and Mei- Pying Cheng*

Effects of irritation of pig wastewater with anaerobic fermentation on the growth of nilegrass (Acroceras macrun) pasture soil and leaching water
*Chi-Hsin Lu and Fu-Hsing Hsu*

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Effects of different heating methods on pork starch sausage quality in refrigeration
*Wen-Shyan Chen, Suey-Ping Chi, Rung-Jen Tu and Yi-Chao Chen*

Evaluation of green manure crops used for forages II. Determination of silage quality of green manure crops
*Shyh-Rong Chang, Chi-Hsin Lu, Yu-Yen Chen, Siyi-Ciyuan Chang, Wun Chen, Sua-Fyuan Yen and Fu-Hsing Hsu*

Study on the carcass characteristics of Chinese hybrid geese in Taiwan
*Chih-Chang Hsiao, Kuo-Chin Wu and Yu-Shine Jea*

Investigation of growth rate and body size in Taiwan water buffaloes (*Bubalus bubalis*)
*Liang-Yuan Wei, Jyh-Iong Huang, Hsiao-Yun Kuo, Yu-Shine Jea and Cheng-Yung Lin*

Breeding of prolific swine: I. The performance of KHAPS Black Pig
*Chin-Bin Hus, Shen-Chang Chang, Yen-Jung Chan, Hsien-Juang Huang, Chih-Hua Wang, Hai-Nan Twu, Chia-Hsuan Chen, Ming-Che Wu, Hsiu-Luan Chang and Cheng-Taung Wang*

Construction of bacterial artificial chromosome libraries of Brown Tsaiya ducks
*Ren-Bao Liaw, Wen-Ying Huang, Mei-Ru Chen, Hsiu-Chou Liu, Ming-Che Wu and Mei-Ping Cheng*

Study on the excretion of copper zinc in broilers
*Tein-Ming Su, Shine-Ming Liou, Hsiao-Lung Liu, Bor-Ling Shih and Meeng-Ter Koh*

A survey of duck excreta: quantity and composition
*Jung-Hsin Lin, Chin-Hui Su, Shuen-Rong Lee, Tein-Ming Su, Shen-Chang Chang, Meeng-Der Koh and Jeng-Fang Huang*

Effects of adding urea-protein into goat ration on the growth performance, carcass performance and serum parameters of fattening castrated goat
*Jia-Shian Shiu, Shen-Shin Yung, Sheng-Der Wang, Chi-Jen Feng, Ruey-Chuen Hsieh and An-Kuo Su*

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Effects of the practicl diets with three levels of protein and two levels of energy on the growth performance of silky chickens during 4-8 weeks of age
*Yih-Fwu Lin, Hsiao-Lung Liu, Che-Ming Hung, Yu-Shin Cheng and Chao-Hsien Hsieh*

The effects of bee propolis and butyric acid on growth performances of Taiwan native chickens
*Yih-Fwu Lin, Hsiao-Lung Liu, Che-Ming Hung, Min-Yang Tsai and Chao-Hsien Hsieh*

Effects of organic ration on the carcass characteristics and meat quality of castrated Taiwan native black goat
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# Scientist sent abroad for advanced study, investigation, or participation in international symposia

| Position | Name | Subject | Country | Date |
|---|---|---|---|---|
| Assistant Researcher | D. C. Wang | The technique of goat laparoscopic ovum pick-up | France | Apr. 29 - May 12, 2010 |
| Researcher and Chief | C. F. Lee | Enhancement the technology in diet manipulation and by-products utilization for dairy cattle | Israel | May 22 - J une 4, 2010 |
| Researcher and Director of Branch | J. F. Huang | Studies on the mechanism of heat stress affecting the laying and growth performance in poultry and the measures to alleviate heat stress | USA | July 17 - 28, 2010 |
| Associate Researcher | H. F. Lee | Study on the organic production system concerning of animal welfare of pigs in Germany | Germany | Aug.6 - 19, 2010 |
| Associate Researcher | L.Y.Wei | Studying the way for duck semen stored in low temperature | France | Aug. 20 - Sep. 3, 2010 |
| Assistant Researcher | S. C. Chang | Study on hatchability and embryo culture of egg in geese | Japan | Sep. 6 - 10, 2010 |
| Director | I. H. Huang | Exchange of livestock technology between Taiwan and France | France | Sep. 12 -2 2, 2010 |
| Associate Researcher | Y. F. Lin | Exchange of livestock technology between Taiwan and France | France | Sep. 12 -2 2, 2010 |
| Associate Researcher | J. W. Shiau | Study on the effect of oocyte quality and gene expression on the developmental competence of SCNT embryos | France | Sep. 12 - 22, 2010 |
| Assistant Researcher | T. C. Kang | Technology of separation sperm sex by cell sorter | Australia | Dec. 7 - 17, 2010 |
| Researcher and Director of Branch | J. C. Huang | The improvement of semen frozen and artificial insemination techniques in goat | France | May 1 - 14, 2011 |
| Associate Researcher | H. F. Lee | Study on the low input and humane management of livestock production in Britain | UK | June 22 - July 5, 2011 |
| Associate Researcher | J. W. Shiau | Study on the effect of culture system of poultry germ cells on gene expression and its potential for transgenic research | France | July 17 - 30, 2011 |
| Associate Researcher | J. B. Lin | Forage germplasm collection and exchange between Taiwan and Vietnam | Vietnam | July 25 - Aug. 7, 2011 |
| Associate Researcher | R. B. Liaw | Cooperation and exchange of gene banks of livestock germplasms between Vietnam and Taiwan | Vietnam | July 25 - Aug. 7, 2011 |
| Associate Researcher and | C. S. Chen | Study of the effects of climate change on forage production and grassland | Japan | Aug. 18 - 31, 2011 |

| Position | Name | Subject | Country | Date |
|---|---|---|---|---|
| Chairperson | | environment | | |
| Associate Researcher and Chief | M. C. Cheng | The application and management of chicken litter in Japan | Japan | Aug. 24 - 29, 2011 |
| Assistant Researcher | S. R. Chang | Study on forage production responding to climate change | Canada | Oct. 23 - Nov. 4, 2011 |
| Associate Researcher | H. H. Wu | Exchange of livestock technology between Taiwan and the Netherlands herbivores and poultry | Holland | Nov. 7 - 20, 2011 |

# Training Classes

| Program | Trainee | Duration |
|---|---|---|
| **2010** | | |
| AI of dairy cattle | 31 | 8 days |
| Mastitis prevention of dairy cow | 18 | 3 days |
| Utilization and safety for meat additives | 42 | 1 day |
| Lameness control and prevention for cattle | 25 | 4 days |
| Chicken and egg processing | 49 | 2 days |
| Feed analysis | 19 | 3 days |
| Forage species identification | 32 | 3 days |
| Meat processing | 42 | 2 days |
| Management of pig | 15 | 5 days |
| Management of Poultry | 28 | 22 days |
| **2011** | | |
| Feed analysis | 23 | 3 days |
| AI of deer | 26 | 3 days |
| AI of goat | 23 | 3 days |
| Forage species identification | 48 | 3 days |
| Management of pig | 20 | 10 days |
| Meat processing | 51 | 2 days |
| Livestock products processing | 33 | 10 days |
| Management of cattle | 27 | 20 days |
| Introduction of livestock | 58 | 3 days |

# Seminars and symposia

| Speaker | Topic | Nation | Data |
|---|---|---|---|
| **First season academic seminar** | | | |
| J. C. Lin | The impact of feed on food sanitation and safety. | Taiwan | Mar. 19, 2010 |
| P. C. Tang | Screening by the Xenopus laevis egg extracts treated with differentiation of pluripotent cells. | Taiwan | Mar. 19, 2010 |
| J. R. Lin | Certification system of domestic lamb store. | Taiwan | Mar. 19, 2010 |
| J. M. Hong | Resources to handle a large number of animal carcass-introduction. | Taiwan | Mar. 29, 2010 |
| P. K. Lei | Resources to handle a large number of animal carcass-preparation. | Taiwan | Mar. 29, 2010 |
| Felipe P. Reolalas | An overview of the Philippine duck industry. | Taiwan | Apr. 12, 2010 |
| Ireneo C. Santiago | Recent Researches on the duck industry in the Philippine. | Taiwan | Apr. 12, 2010 |
| P. Chong | Livestock and carbon reduction. | Taiwan | Apr. 13, 2010 |
| **Second season academic seminar** | | | |
| C. H. Chou | Biodiversity of miscanthus plants: from ecology to molecular evolution. | Taiwan | Jun. 14, 2010 |
| H. P. Su | Current situation and development trend of domestic diversification of egg products. | Taiwan | Jun. 14, 2010 |
| C. M. Lai | Countermeasures of reduction greenhouse gas by use life cycle assessment, example for livestock. | Taiwan | Jun. 14, 2010 |
| Simon Paulde Graaf | Application of sexed sperm. | Taiwan | Jun. 14, 2010 |
| **Minipigs in biomedical research 2010 Taiwan** | | | |
| Y. Y. Sung | The past and future of Lanyu Mini - pig. | Taiwan | Aug. 21, 2010 |
| R. K. Li | Swine Model in Cardiovascular Research. | Taiwan | Aug. 21, 2010 |
| H. K. Yip | Immediate intramyocardial bone marrow-derived mononuclear cells implantation in Mini-pig myocardium after permanent coronary artery ligation: MRI, IHC and molecular studies. | Taiwan | Aug. 21, 2010 |
| Y. D. Lin | A tissue engineering approach for cardiac repair in pigs. | Taiwan | Aug. 21, 2010 |
| Kuo Yuan | Enhance oral tissues regeneration using porcine embryonic stem cells. | Taiwan | Aug. 21, 2010 |
| T. F. Kuo | Lanyu small-ear pig used for study of bio-tooth regeneration and articular cartilage repair. | Taiwan | Aug. 21, 2010 |
| Soo Jay Louis Phee | Porcine experiments related to robotics in gastroenterology. | Taiwan | Aug. 21, 2010 |
| Y. J. Chao | Distal pancreatectomy using needle arrays under alternating electromagnetic fields. | Taiwan | Aug. 21, 2010 |
| Y. S. Shan | Bloodless liver resection using needle arrays under alternating electromagnetic fields. | Taiwan | Aug. 21, 2010 |
| Y. T. Wu | Coarctation-induced abdominal aortic aneurysm in a porcine model. | Taiwan | Aug. 21, 2010 |
| Toshiyuki Sakurai | A training system for gastric ESD in NCGM. | Taiwan | Aug. 22, 2010 |
| C. J. Lo | Partial splenectomy using an electromagnetic thermal surgery system in Lanyu pigs. | Taiwan | Aug. 22, 2010 |

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|---|---|---|---|
| Charles Henri Malbert | The pig as a human model for functional imaging. | Taiwan | Aug. 22, 2010 |
| L. K. Wang | Differential expression of nucleus accumbens proteome in a porcine model of morphine tolerance. | Taiwan | Aug. 22, 2010 |
| Y. R. Kuo | Advanced organ transplant model in miniature swine: composite tissue allotransplantation. | Taiwan | Aug. 22, 2010 |
| H. T. Lee | Pigs for bio - organ research. | Taiwan | Aug. 22, 2010 |
| Fulton Wong | Rhodopsin P347L transgenic pig for retinitis pigmentosa (RP) research. | Taiwan | Aug. 22, 2010 |
| F. R. Chang | Official document writing. | Taiwan | Agu. 30, 2010 |
| **Third season academic seminar** | | | |
| R. B. liai | Research livestock metagenomics. | Taiwan | Sep. 07, 2010 |
| W. S. Ke | The skills of thesis writing and researching approach in international SCI periodicals (Teaching experience). | Taiwan | Sep. 07, 2010 |
| H. M. Huang | Press release writing. | Taiwan | Sep. 07, 2010 |
| Yann Locatelli | Assessment on laparoscopic ovum pick- up in goat. | Taiwan | Sep. 10, 2010 |
| Paul Miller | Present status and development of the U.S. A. layer industry. | Taiwan | Sep. 14, 2010 |
| **Assisted reproductive technologies for livestock genetic improvement** | | | |
| Dr. Okeyo Mwai | Principles and application of AI in mammalian species - new development and field applications in developing countries. | Taiwan | Oct. 25 - 28, 2010 |
| J. C. Huang | Artificial reproductive technology in goats. | Taiwan | Oct. 25 - 28, 2010 |
| C. M. Wang | Preparation technology for porcine frozen semen. | Taiwan | Oct. 25 - 28, 2010 |
| M. C. Wu | Principles and application of AI in poultry species - new development and field applications in developing countries. | Taiwan | Oct. 25 - 28, 2010 |
| Y. F. Lin | Artificial insemination technology in native chickens. | Taiwan | Oct. 25 - 28, 2010 |
| S. C. Liu | Artificial insemination technology in ducks. | Taiwan | Oct. 25 - 28, 2010 |
| M. J. Lin | Artificial insemination technology in geese. | Taiwan | Oct. 25 - 28, 2010 |
| M. C. Wu | Demonstration of AI of mammals and poultry including basic equipments, procedures and a demo. | Taiwan | Oct. 25-28, 2010 |
| C. M. Wang<br>H. F. Lee | Preparation technology for porcine frozen semen. | Taiwan | Oct. 25 - 28, 2010 |
| Gyu-Jin Rho | Porcine mesenchymal stem cells: Comparative characterization and its applications. | Taiwan | Oct. 25 - 28, 2010 |
| Okeyo Mwai | Embryo transfer and in vitro fertilization - new development and field applications in developing countries. | Taiwan | Oct. 25 - 28, 2010 |
| Gyu-Jin Rho | Advanced reproductive technology: Application of nuclear transfer and somatic cell manipulation in livestock conservation and genetic improvement. | Taiwan | Oct. 25 - 28, 2010 |
| J. R. Yang | Study on porcine stem cells. | Taiwan | Oct. 25 - 28, 2010 |
| J. W. Shiau | Somatic cell cloning technology. | Taiwan | Oct. 25 - 28, 2010 |
| F. H. Chu<br>J. R. Yang | Demonstration of modern reproductive technology: In vitro fertilization, embryo and somatic cell manipulation. | Taiwan | Oct. 25 - 28, 2010 |
| Dr. Jawahir L. Karihaloo | Harnessing biotechnology in agriculture - a regional perspective. | Taiwan | Oct. 25 - 28, 2010 |
| D. Y. Lin | Genomic breeding technology in native chickens. | Taiwan | Oct. 25 - 28, 2010 |
| Ran Solomon Head | Feeding management of the Israel dairy herd - facts and highlights. | Taiwan | Nov. 10, 2010 |

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|---|---|---|---|
| Gaby Adin Head | Feeding and managing calves and replacement heifers in Israeli. | Taiwan | Nov. 10, 2010 |
| M-E. Christel | Current state of French duck researches: recent results and future plans. | Taiwan | Dec. 01, 2010 |
| H. Garreau | Rabbit organization, farming technics and genetic improvement at INRA. | Taiwan | Dec. 01, 2010 |
| T. Gidenne | Rabbit feeding and nutrition. | Taiwan | Dec. 01, 2010 |
| **Fourth season academic seminar** | | | |
| J. W. Shiau | Experience sharing after finished the training program of multi-disciplinary for senior personnel in technology management. | Taiwan | Dec. 21, 2010 |
| C. Y. Wang | Herbicides commonly used in Taiwan. | Taiwan | Dec. 21, 2010 |
| S. Y. Wang | The inter-relationships between poultry production and climate change. | Taiwan | Dec. 21, 2010 |
| M. J. Chen | Milk: Can a "good" food be so bad? | Taiwan | Dec. 21, 2010 |
| J. P. Poivey | Small ruminant breeding application of genomic selection. | Taiwan | Jan. 16, 2011 |
| **First season academic seminar** | | | |
| J. C. Lee | Influence of plasticizer on the reproductive system and development of growth. | Taiwan | Mar. 16, 2011 |
| W. F. Chen | Microbiology lab practices and safety rules. | Taiwan | Mar. 16, 2011 |
| S. B. Chu | New minipig breed for biomedical research: Binlang (Lanyu 400). | Taiwan | Mar. 16, 2011 |
| **Livestock and poultry sperm fitness tests technical seminars** | | | |
| T. Y. Kuo | Sperm fitness tests technology of boar. | Taiwan | Mar. 16, 2011 |
| J. M. Wamg | Semen quality testing technology of boar. | Taiwan | Mar. 16, 2011 |
| G. H. Lee | Semen quality testing and frozen semen production technology of dairy cows. | Taiwan | Mar. 16, 2011 |
| D. G. Wang | Semen quality testing technology of goat. | Taiwan | Mar. 16, 2011 |
| S. H. Lin | Semen quality testing technology of sambar. | Taiwan | Mar. 16, 2011 |
| L. Y.Wuei | Semen quality testing technology of duck. | Taiwan | Mar. 16, 2011 |
| C. F. Liou | Semen quality testing and frozen semen production technology of cock. | Taiwan | Mar. 16, 2011 |
| M. R. Lin | Semen quality testing technology of goose. | Taiwan | Mar. 16, 2011 |
| **Seminar of duck technique** | | | |
| Y. S. Cheng | The breeding and traits performance of Brown Tsaiya LRI No. 2 and line selecting for long fertilization duration. | Taiwan | Apr. 28, 2011 |
| S. H. Lee | The biosecurity and epidemic prevention of breed duck farm praticl. | Taiwan | Apr. 28, 2011 |
| H. C. Lee | The present situation of duck industry of China. | Taiwan | Apr. 28, 2011 |
| S. C. Liou | Brief introduction for traits performance of breed duck at Ilan branch institute. | Taiwan | Apr. 28, 2011 |
| **First season academic seminar of forage crops** | | | |
| F. H. Hsu | Application of life cycle assessment in agricultural research. | Taiwan | May 19, 2011 |
| Y. S. Jea | Automatization of animal factory-goose farm for example. | Taiwan | May 19, 2011 |
| J. B. Lin | Cluster analysis of napiergrass germplasms in Taiwan. | Taiwan | May 19, 2011 |
| M. L. Chang | Study on promotors of the peroxidase genes of different rice varieties. | Taiwan | May 19, 2011 |

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| S. H. Liang | Current status and outlook of treating livestock waste with black soldier fly. | Taiwan | May 19, 2011 |
| **Breeding & genetics of black pigs** | | | |
| H. F. Lee | Sign in TLRI Black Pig No. 1 and the current situation of performance selection. | Taiwan | Jun. 7, 2011 |
| C. B. Siyu | Sign in KHAPS Black Pig and the current situation of performance selection. | Taiwan | Jun. 7, 2011 |
| Y. Y. Song | The view of breeding of black pigs. | Taiwan | Jun. 7, 2011 |
| Y. S. Wu | Experience sharing of feeding TLRI Black Pig No. 1. | Taiwan | Jun. 7, 2011 |
| Y. S. Cheng | Experience sharing of feeding KHAPS Black Pig. | Taiwan | Jun. 7, 2011 |
| C. H. Hang | Processed meat products of KHAPS Black Pig. | Taiwan | Jun. 7, 2011 |
| **Second season academic seminar** | | | |
| Y. J. Chiang | Weed management in the field crops. | Taiwan | Jun. 14, 2011 |
| C. L. Chen | Feasibility assessment of swine wastewater reuse in agricultural land. | Taiwan | Jun. 14, 2011 |
| Y. Liang | Characteristics and applications of lactoferrin. | Taiwan | Jun. 14, 2011 |
| Dr. Cone | A brief introduction of Wageningen university. | Taiwan | Jun. 20, 2011 |
| Dr. Cone | Production and conservation of forages in The Netherlands. | Taiwan | Jun. 20, 2011 |
| **Goat diseases and prevention seminars** | | | |
| S. D. Chuang | Doe respiratory disease. | Taiwan | Jul. 20, 2011 |
| S. D. Chuang | Doe abortion, mastitis and metabolic disorders. | Taiwan | Jul. 20, 2011 |
| **Livestock management and carbon reduction seminar** | | | |
| S. C. Lee | Introduction of organic fertilizer. | Taiwan | Jul. 27, 2011 |
| T. M. Su | The effect of copper and zinc content in the feed of laying hens on production performance. | Taiwan | Jul. 27, 2011 |
| H. L. Liou | The use of radio-frequency identification (*RFID*) on native chickens' traceability. | Taiwan | Jul. 27, 2011 |
| J. H. Su | Basic information to establish environmental control duck house air pollutants. | Taiwan | Jul. 27, 2011 |
| S. H. Liang | Current status and outlook of treating livestock waste with black soldier fly. | Taiwan | Jul. 27, 2011 |
| M. P. Chen | Study greenhouse gases generated by the livestock waste treatment. | Taiwan | Jul. 27, 2011 |
| M. C. Cheng | Effect of use different anaerobic fermentation of cattle manure wastewater to produce methane. | Taiwan | Jul. 27, 2011 |
| C. H. Lu | Carbon storage capacity of the domestic perennial pasture. | Taiwan | Jul. 27, 2011 |
| C. S. Chen | Carbon reduction forage crops production. | Taiwan | Jul. 27, 2011 |
| C. Y. Lee | The effect of diet composition and additives on rumen fermentation and methane generation. | Taiwan | Jul. 27, 2011 |
| **Dairy cattle of breeding information application seminar** | | | |
| C. Y. Chen | Imports of semen genetic evaluation of information inquiries and applications in dairy. | Taiwan | Sep. 09, 2011 |
| Y. C. Huuang | Holstein pedigree information and inbreeding coefficient. | Taiwan | Sep. 09, 2011 |
| G. H. Lee | E-management in dairy farm. | Taiwan | Sep. 09, 2011 |
| **Third season academic seminar** | | | |

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|---|---|---|---|
| C. H. Bai | Application of gene chip. | Taiwan | Sep. 13, 2011 |
| C. H. Chiu | Investigate molecular mechanism of metabolic disease using induced animal model. | Taiwan | Sep. 13, 2011 |
| C. B. Siyu | Glutamine characteristics and use in weanling piglet feed. | Taiwan | Sep. 13, 2011 |
| Alice Fatet | Artificial insemination of dairy goat in France. | Taiwan | Sep. 26, 2011 |
| Y. S. Jiia | Geese feeding and management. | Taiwan | Sep. 28, 2011 |
| M. R. Lin | The assessment of body condition score on breeder reproductive performance. | Taiwan | Sep. 28, 2011 |
| S. C. Chang | RFID technology is applied goose precision management. | Taiwan | Sep. 28, 2011 |
| Eduardo Manfredi | Linear appraisal of dairy goat in France. | Taiwan | Oct. 03, 2011 |
| Michael Appleby | Farm animal welfare and sustainability in Europe and worldwide. | Taiwan | Oct. 18, 2011 |
| **Heng - Chun branch of industrial technology conference** | | | |
| C. S. Chen | The rational management of production of forage corn. | Taiwan | Oct. 27, 2011 |
| S. M. Wang | Silage inoculant development and improvement of silage quality. | Taiwan | Oct. 27, 2011 |
| C. H. Siyu | Urea applied in goat. | Taiwan | Oct. 27, 2011 |
| C. R. Feng | The establishment of e-mode of the goat-milking. | Taiwan | Oct. 27, 2011 |
| D. C. Wang | Simulated courtship situation in goat artificial reproductive regulation. | Taiwan | Oct. 27, 2011 |
| S. H. Yang | Feasibility study in production of organic goat by use Leucaena. | Taiwan | Oct. 27, 2011 |
| **International symposium on genetics and reproductive management for animal production** | | | |
| C. L. Chang | Genetics of Taiwan Holstein. | Taiwan | Nov. 21-23, 2011 |
| K. H. Lee | Reproductive managements of Taiwan Holstein. | Taiwan | Nov. 21-23, 2011 |
| F. H. Chu | Application of sexed sperm. | Taiwan | Nov. 21-23, 2011 |
| D. C. Wang | Genetics of Alpine, Saanen, Boer and Nubian. | Taiwan | Nov. 21-23, 2011 |
| J. C. Haung | Reproductive management of Alpine, Saanen, Boer and Nubian. | Taiwan | Nov. 21 -23, 2011 |
| Victor C. Atienza | Quarantine of livestock and poultry in Philippine. | Taiwan | Nov. 21-23, 2011 |
| H. M. Liang | Genetics of Formosan sambar deer. | Taiwan | Nov. 21-23, 2011 |
| S. H. Lin | Reproductive management of Formosan sambar deer. | Taiwan | Nov. 21-23, 2011 |
| Nguyen Thanh Son | Quarantine of livestock and poultry in Vietnam. | Taiwan | Nov. 21-23, 2011 |
| M. C. Wu | Genetics of Duroc, Landrace and Yorkshire pig. | Taiwan | Nov. 21-23, 2011 |
| N. T. Yen | Reproductive managements of Duroc, Landrace and Yorkshire pig. | Taiwan | Nov. 21-23, 2011 |
| H. C. Liu | Genetics of Tsaiya, Pekin and White Muscovy ducks. | Taiwan | Nov. 21-23, 2011 |
| J. F. Huang | Reproductive management of Tsaiya, Pekin and White Muscovy ducks. | Taiwan | Nov. 21-23, 2011 |
| D. Y. Lin | Genetics of TLRI-1, TP, KS, FH and Silkie chicken. | Taiwan | Nov. 21-23, 2011 |
| Y. F. Lin | Reproductive management of TLRI chicken. | Taiwan | Nov. 21-23, 2011 |
| J. B. Lin | Major forage cultivars in Taiwan. | Taiwan | Nov. 21-23, 2011 |
| Prapas Pinyocheep | Quarantine of livestock and poultry in Thailand. | Taiwan | Nov. 21-23, 2011 |
| M. J. Lin | Genetics of Beidou White goose. | Taiwan | Nov. 21-23, 2011 |
| S. C. Chang | Reproductive management of Beidou White goose. | Taiwan | Nov. 21-23, 2011 |

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| Mohd Jahar | Quarantine of livestock and poultry in Malaysia. | Taiwan | Nov. 21-23, 2011 |
| Jawahir Lal Karihaloo | Role of biotechnology in improving agricultural productivity and poverty alleviation in the Asia-Pacific region. | Taiwan | Nov. 21-23, 2011 |
| L. Y. Wei | Pathogen free embryonic egg of White Muscovy for vaccine production. | Taiwan | Nov. 21-23, 2011 |
| H. H. Wu | Production of Taiwan white rabbit. | Taiwan | Nov. 21-23, 2011 |
| **Second season academic seminar of forage crops** | | | |
| A. K. Su | Study on forage digestibility of goat. | Taiwan | Nov. 22, 2011 |
| C. S. Chen | Forage production in response to climatic change. | Taiwan | Nov. 22, 2011 |
| Y. M. Shy | Opportunity of domestic forage against the imported hay. | Taiwan | Nov. 22, 2011 |
| Y. K. Cheng | Introduction of new cultivar Napiergrass Taishu No. 5. | Taiwan | Nov. 22, 2011 |
| S. R. Chang | Forage yield, chemical content and silage quality of manure soybean. | Taiwan | Nov. 22, 2011 |
| **The Netherlands -Taiwan seminar on precision livestock farming** | | | |
| J.B. (Bennie) van der Fels | General introduction of the Netherlands pig farming industry. | Taiwan | Nov. 24, 2011 |
| Andries Jan Oosterhof | Modern animal feeding system. | Taiwan | Nov. 24, 2011 |
| Caroline Chu | IDAL - no - needle vaccination for pigs. | Taiwan | Nov. 24, 2011 |
| Bart Hooijer | Control equipment for livestock housing. | Taiwan | Nov. 24, 2011 |
| Volker Engelbach | Automated red meat slaughtering & meat packing technology. | Taiwan | Nov. 24, 2011 |
| C. D. Lin | Pig production in Taiwan. | Taiwan | Nov. 24, 2011 |
| Y. N. Wan | Research & development of PLF in Taiwan. | Taiwan | Nov. 24, 2011 |
| H. L. Liu | The use of RFID on the traceability of native and broiler chickens and procedure and management of chicken farms (North Hsinchu). | Taiwan | Nov. 24, 2011 |
| H. L. Liu | The use of RFID on the traceability of native and broiler chickens and procedure and management of chicken farms (Changhua). | Taiwan | Nov. 25, 2011 |
| **Native farm animals (AnGR) of Taiwan and Philippines** | | | |
| Manuel R. Jarmin | Philippines animal genetic resources management. | Taiwan | Nov. 28, 2011 |
| M. C. Wu | Livestock and poultry genetic diversity - global perspective. | Taiwan | Nov. 28, 2011 |
| C. H. Su | The diversity of duck meat and egg products. | Taiwan | Nov. 28, 2011 |
| H. Y. Kuo | Central testing of Taiwan game hen in growth performance and carcass traits. | Taiwan | Nov. 28, 2011 |
| Agapita, J. Salces | Research initiatives of the academe on the Philippine animal genetic resources development in the Philippines. | Taiwan | Nov. 28, 2011 |
| Synan S. Baguio | Gains from native animals improvement, promotion and utilization R&D investments. | Taiwan | Nov. 28, 2011 |
| H. L. Liu | The use of RFID on the traceability of native and broiler chickens and procedure and management of chicken farms (Tainan). | Taiwan | Dec. 06, 2011 |
| **Animal industry of Taiwan and Vietnam** | | | |
| Le Thi Thuy | Prioritized issues in research for income improvement of small livestock producers in Vietnam. | Taiwan | Dec. 12, 2011 |

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| General Director Hoang Kim Giao | Current status of livestock production and direction of development in coming years. | Taiwan | Dec. 12, 2011 |
| **Fourth season academic seminar** | | | |
| T. M. Leou | The relationship between Taiwan 24 solar terms and climatology - 1981~2010 data statistics. | Taiwan | Dec. 20, 2011 |
| T. S. Siiao | Process kinetics of an activated-sludge reactor system treating poultry slaughterhouse wastewater. | Taiwan | Dec. 20, 2011 |
| M. P. Chen | Application and management of chicken manure in Japan. | Taiwan | Dec. 20, 2011 |
| **Workshop on dairy manure biogas used for electricity generation** | | | |
| M. D. Koh | Production and purification of dairy manure biogas. | Taiwan | Dec. 22, 2011 |
| J. C. Chen | Benefit evaluation of micro turbine generator utilizing dairy manure biogas. | Taiwan | Dec. 22, 2011 |