

# 2<sup>ND</sup> FATTY PIG



SCIENCE AND UTILIZATION  
INTERNATIONAL CONFERENCE

Program  
Abstracts  
List of Participants

November 20 to 22, 2013  
Herceghalom, Hungary



# Program

## Wednesday, 20 November 2013

18:00 Welcome party

## Thursday, 21 November 2013

### 09:15 **Opening ceremony**

Opening Remarks

*Lajos Bognár*

*Deputy State Secretary*

*State Secretariat for Food Chain Supervision and Agricultural Administration*

*Ministry of Rural Development*

Looking back to the 1<sup>st</sup> Fatty Pig Meeting

*József Rátky*

*Director General*

*Research Institute for Animal Breeding and Nutrition*

### 09:40 **Session 1 – Genetics**

*Chair: Adrienn Micsinai*

09:40 Molecular studies of the genetic basis of fatness traits in Iberian pigs

*Cristina Ovilo Martin*

10:00 Genetic studies in Mangalica via genome wide screening approach

*Attila Zsolnai*

10:20 Genetic variability of the Hungarian Blonde Mangalica population

*János Posta, Péter Szabó*

10:40 A comparative genetic analysis of the fatty Mangalitza pig and other wild boar populations from Eurasia

*Adrian Valentin Baltenau*

### 11:00 **Coffee break**

### 11:30 **Session 2 – Breeding – Reproduction**

*Chair: István Egerszegi*

11:30 Overview of fatty pig breed's reproductive physiology

*Klaus Peter Brüssow*

11:50 New perspectives of in vitro gamete preservation: xenografting of testicular tissues

*Kazuhiro Kikuchi*

- 12:10 Signal transduction during fertilization in pig oocytes with special regard on gene preservation  
*Zoltán Macháty*
- 12:30 Embryo viability and offspring development in Iberian pigs  
*Antonio Gonzales Bulnes*
- 12:50 Lunch**
- 14:20 *Session 3 – Breeding – Technology & feeding management***  
*Chair: Lucky Nedambele*
- 14:20 The effect of protein concentration in diet on age of attainment of puberty and libido test of indigenous Kolbroek boars  
*Lucky Nedambele*
- 14:40 Current aspects of Thai fatty pig  
*Narut Thanantong*
- 15:00 European feeding strategies in fatty pig production  
*Miklós Mézes*
- 15:20 Fertility of Fatty Pigs in Austria - a field data study  
*Beate Berger*
- 15:40 Coffee break**
- 16:10 *Session 4 – Impact of policy and science on premium pork production – Cross cut***  
*Chair: Zsolt Feldman*
- 16:10 Research Institute of Animal Breeding and Nutrition in National Swine Strategy  
*József Rátky*
- 16:30 General discussion  
Fatty pig breeds and modern pigs fattened to big weight - Competition or cooperation
- 18:00 *Traditional Hungarian pork dinner***

**Friday, 22 November 2013**

**09:00 Session 5 – Potential role in Rural Development & Social policy**

*Chair: Jędrzej Jaskowski*

09:00 Pig breeding in upland rural area of the Lao PDR

*István Egerszegi, Soukanh Keonuchan*

09:20 Crossing programs of fatty pigs in Spain (Celtic pig)

*Antonio Carris*

09:40 Vertical production system in Hungarian small scale mangalica farm

*Zoltán Kővér*

**10:00 Session 6 – Product development – Tradition and Quality control**

*Chair: Tamás Éder*

10:00 High expression of decoy receptor-3 in granulosa cells of mangalica pig ovaries

*Noboru Manabe*

10:20 Physiological effects of Mangalica meat

*Csiki Zoltán*

**10:40 Coffee break**

11:10 Traceability from barn to consumer

*Adrienn Micsinai*

11:30 Product preferences in different part of the World

*Péter Tóth*

**11:50 Session 7 – Future tasks in fatty pig applied science – Round table discussion**

*Chair: József Rátky*

**12:50 Closing session**

**13:00 Lunch**

**Saturday, 23 November 2013**

09:00 Full day technical tour, including a visit to a Mangalica farm

## **Abstracts**

Oral presentations

## MOLECULAR STUDIES OF THE GENETIC BASIS OF FATNESS TRAITS IN IBERIAN PIGS

Cristina Óvilo

*Department of Animal Genetics, INIA, Avda. Puerta de Hierro s/n. 28040 Madrid, Spain*

Iberian pig breed is a genetically well differentiated breed, characterized by a high potential for fat deposition. This great abundance of subcutaneous and intramuscular fat is an adaptive mechanism, known as thrifty genotype, to strong oscillations of feeding and climate conditions. Thrifty genotypes lead to obesity when food is in excess, mainly due to a dysfunction in appetite and to the ability to store excess fat and lower basal metabolism, as a mechanism intended to face periods of scarcity. This extreme adipogenic trend, joint with high circulating leptin levels paradoxically coincident with great voluntary feed intake, and reproductive limitations makes Iberian pigs suitable to be considered an obese porcine breed with *leptin resistance*. The absence of introgression into its genetic pool of Asian porcine genes, common in other western breeds, is an additional singularity of the Iberian breed.

Due to its genetic and phenotypic singularity, Iberian breed has been considered an interesting animal material for the study of the genetic basis of fatness and other important productive and reproductive traits. In this sense, different experimental populations have been generated from the cross of this breed with both Landrace and Meishan animals, in order to investigate genomic regions affecting productive and reproductive traits, respectively. Particularly, the Iberian strain used in both crosses is a highly inbred black hairless one (Guadyerbás) with an extremely fat body composition. Employment of these experimental populations has allowed the identification of genomic regions affecting several fatness and related traits, in QTL and SNP genome wide association studies. The most significant results were found on SSC4, SSC6 and SSC8. Candidate gene characterization and association studies have been performed with SNPs located in several genes (as *LEPR*, *LEP*, *MTTP*, *ELOVL6* and *FABPs*) reporting some successful reports. Specifically, *LEPR* and *LEP* genes have been studied in several populations, yielding the most interesting results. Recently, SNP and gene expression studies have confirmed the interest and the potential causality of *LEPR* polymorphisms on fatness traits.

At last, programming epigenetic processes seem to have a main role in modulating the function of genes involved in adipogenesis, nutrient metabolism and energy balance. Recent prenatal programming studies have shown that the genetic predisposition for obesity of Iberian pigs is modulated by nutrition in prenatal stages, by changes in the expression of several genes involved in the control of energy balance.

## GENETIC STUDIES IN MANGALICA VIA GENOME WIDE SCREENING APPROACH

Attila Zsolnai

The whole genome of Mangalica animals has been and being screened on the Illumina porcine chip providing basis of prompt utilisation in breeding plans and that of NGS approaches. As an outcome we were/are able (i) to point on those regions, which are unique in Mangalica; (ii) to replace the previously applied ten microsatellite markers by nine SNP loci to classify the Blond, Swallow-Belly and Red Mangalica individuals into three different breed groups ( $p > 0.95$ ), (which SNP regions are good targets for looking breed specific sequences); (iii) to propose 54 SNP loci for parentage testing in Mangalica pigs where the exclusion probability is 0.999115 if one parent is known and the probability of identity is  $1.54E-23$ .; (iv) to perform a pilot and a more extended study using fertility related phenotypic data; (v.) to conduct feeding experiments to see which genomic regions are associated with better feed intake or feed conversion.

## GENETIC VARIABILITY OF THE HUNGARIAN BLONDE MANGALICA POPULATION

János Posta, Péter Szabó

The aim of the research study was the analysis of the pedigree information of the registered Hungarian Blonde Mangalica population. The pedigree file contained information of 19,156 animals from 1980 to 2011. Various measures of genetic variability were calculated, as pedigree completeness, number of ancestors, generation interval, inbreeding level and the distance between boar lines. The dataset was analysed using the ENDOG software.

The longest generation interval was found for in the father-to-son path (2.99 years) whereas the smallest the found for mother-to-daughter path (2.32 years), respectively. Significant ( $P<0.05$ ) differences were found between the father-to-son and father-to-daughter pathways among the four pathways. Similarly, mother-to-son and mother-to-daughter pathways differed significantly ( $P<0.05$ ).

The pedigree completeness was 100 % for more than 90% of piglets born in 2010 and 2011. The quality of pedigree information decreased between 1995 and 2000, but it was corrected soon. The average pedigree completeness was 6 for the whole population and 8.15 for the reference population.

There were 412 ancestors responsible for the total genetic variability for the whole population, while 94 ancestors covered the genetic variability of the reference population. The 50% of the genetic variability is covered by 9 and 7 animals for the total population and the reference population, respectively. The reference population can be described with much more ancestors, which suggest noticeable gene loss during the history of the breed.

The effective number of founders was 55, the effective number of ancestors was 26 for the whole population. The effective number of founders was 45, the effective number of ancestors was 19 for the reference population. The ration of the effective number of ancestors and effective number of founders indicates that there was bottle-neck effect during the population history.

There were six boars and four sows among the ten most important ancestors in the whole population. The most important ancestor was a boar covering 3.9% of the total genetic variability. The small percentages are favourable for the genetic maintaining of the population. There were seven boars and three sows among the ten most important ancestors in the reference population. 4.7% of the total genetic variability was covered by the most important ancestors, which is also favourable for maintaining the genetic variability during the gene conversation work.

Although the average inbreeding level of the whole population was 3.86%, there were some extremely inbred animals. The inbreeding level of the reference population was 3.81%, the highest inbred animal was a boar with 7.36% inbreeding coefficient. There were only 6 non-inbred piglets in the reference population.

The Nei-based genetic distance was the highest between “Hortobágy” and “Pécs” and the lowest between “Bácska” and “Rudi” for the nine still existing boar lines.

## A COMPARATIVE GENETIC ANALYSIS OF THE FATTY MANGALITZA PIG AND OTHER WILD BOAR POPULATIONS FROM EURASIA

Valentin Adrian Balteanu<sup>1</sup>, Arianna Manunza<sup>2</sup>, Marcel Amills<sup>2</sup>

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<sup>2</sup>*Center for Research in Agricultural Genomics (CSIC-IRTA-UAB-UB), Campus Universitat Autònoma de Barcelona, Bellaterra 08193, Spain*

Mangalitza is one of the oldest European breeds, being raised 180 years ago in the Austro-Hungarian Empire by crossing diverse local breeds. The most distinctive features of Mangalitza pigs are their curly hair and tasty meat. So far, the origin of this breed has not been properly investigated at the genetic level. Interestingly, analysis of ancient pig samples from Romania revealed the presence of Near Eastern mitochondrial haplotypes at high frequencies, demonstrating the migration of domesticated swine from the Fertile Crescent into Eastern Europe during the Neolithic. In this study, we aimed to investigate the genetic background of Mangalitza pigs by comparing it with that of European (EUWB) and Near Eastern (NEWB) wild boar. With this goal, we have genotyped, with the Illumina Porcine SNP60 BeadChip, 21 wild boar from Spain, Belgium and Russia, 19 wild boar from Iran, Turkey and Armenia; and 20 Mangalitza pigs from Romania. After quality control with the PLINK toolset, a total of 37,167 SNPs were selected to carry out genetic analyses. Expected and observed heterozygosities ( $H_e$  and  $H_o$ ) were higher in Mangalitza pigs ( $H_o=0.358$ ,  $H_e=0.314$ ) than in wild boar populations (NEWB:  $H_o=0.229$ ,  $H_e=0.241$ ; EUWB:  $H_o=0.264$ ,  $H_e=0.292$ ). A multidimensional scaling plot based on genome-wide identity-by-state pairwise distances calculated with PLINK showed that Mangalitza pigs are more closely related to EUWB than to NEWB. This result was confirmed when we analysed the data with Structure *i.e.* at  $K = 2-3$  the genetic background of Mangalitza pigs was essentially European, without traces of a Near Eastern ancestry. We are currently in the process of obtaining 60K SNP data from Romanian wild boar in order to investigate the existence of gene flow between this population and Mangalitza pigs. Preliminary results based on the analysis of mitochondrial cytochrome b sequences suggest the existence of a significant level of genetic differentiation between Mangalitza and Romanian wild boar, but this needs to be confirmed at the autosomal level.

## OVERVIEW ON FATTY PIG BREED'S REPRODUCTIVE PHYSIOLOGY

Klaus-Peter Brüssow<sup>1</sup>, Istvan Egerszegi<sup>2</sup>, Pedro Garcia Casado<sup>3</sup>, Jozsef Rátky<sup>2</sup>

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Most of fatty pig breeds are ancient one and well adapted to environmental and keeping conditions. Although, their pork products are traditionally used, the number of breeding animals is low and they have difficulties to compete with modern breeds. Their fecundity is relatively low and at present, there are only limited reproductive research data.

Based on recent research on Iberian and Mangalica sows, the available results regarding ovarian characteristics and oocyte/embryo development, genital tract morphometry, and endocrinology of the estrus cycle should be highlighted.

Iberian and Mangalica sows reveal only a lower number of ovulations compared to modern pig breeds (e.g. Landrace) and the ovarian response can be only moderately stimulated by exogenous gonadotropins. Their (intrafollicular) oocyte maturation is altered and there are deficiencies in preovulatory follicle growth, ovulatory efficiency, and finally, in oocyte and embryo developmental competence. All these events can be crucial regarding diminished fecundity of these fatty pig breeds. Furthermore, it was demonstrated that growth restricted uterine development is present especially during early pregnancy, which also may influence fecundity. Though, the general release pattern of gonadotropins and steroids do not differ compared to 'modern' breeds, there are considerable differences. There is a significant earlier increase in preovulatory estradiol rise; the pulse release pattern of LH is abolished during the luteal phase of the estrus cycle, and the concentrations of estradiol and progesterone in the follicular fluid of Mangalica is two- and five-times higher than in Landrace. In the circulation near to the ovary, the progesterone concentrations are three-times higher in Mangalica and decrease at the end of the luteal phase about 1.5 days later compared to Landrace. The leptin levels are also increased four-times in Mangalica.

In summary, although reproductive research data in fatty pig breeds are rare, the data obtained in Iberian and Mangalica sows reveal differences in ovarian response, oocyte and embryo developmental competence, uterine development and reproductive hormone secretion which can be assumed as critical reasons of lower fecundity in fatty pig (Iberian, Mangalica) breeds.

The imperfect reproductive data in fatty pig breeds should be a challenge for future research.

## NEW PERSPECTIVES OF IN VITRO GAMETE PRESERVATION: XENOGRAFTING OF TESTICULAR TISSUES

Kazuhiro Kikuchi<sup>1,2\*</sup>, Michiko Nakai<sup>3</sup>, Tamas Somfai<sup>4</sup>, Junko Noguchi<sup>1</sup>, Fuminori Tanihara<sup>2</sup>, Junya Ito<sup>5</sup>, Naomi Kashiwazaki<sup>5</sup>, Hiroyuki Kaneko<sup>1</sup>

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A series of the studies were conducted to evaluate if boar spermatogonia can develop to sperm in testicular tissues grafted into nude mice and live piglets can be generated from zygotes produced by intracytoplasmic sperm injection (ICSI) using these sperm.

Porcine testicular tissues from male piglets were minced into samples measuring 1.5 × 1.5 × 1.5 mm, and transplanted under the skin of the backs of castrated nude mice. Spermatids and spermatozoa were obtained after about 4 months but showed only faint motility, suggesting the need for ICSI to give their ability to fertilize oocytes. Spermatozoa were recovered from 41 of the 65 host mice (63.1%). A single spermatozoon was injected into an in vitro matured porcine oocyte, and the oocytes were electro-stimulated and cultured. Blastocyst rate (24.9%) was higher ( $P < 0.05$ ) than those of parthenogenesis and sham control groups (12.7% and 13.0%, respectively) (Nakai *et al.*, *Theriogenology*, 2009). Their total mean number of cells (41.9 cells) was similar to that of the in vitro fertilized and developed blastocysts (52.7 cells, Kikuchi *et al.*, *Biol Reprod* 2002). When the oocytes 10 h after ICSI at the pronuclear stages were transferred to oviducts of estrous synchronized recipients, 2 out of 23 recipient gilts gave birth to six piglets. (Nakai *et al.*, *Reproduction*, 2010).

For the more advantages, we have checked the possibility of vitrification and cryopreservation before xenografting, which enables long-time storage of the tissue and production of sperm at any time we want. The tissues were incubated in vitrification solution (35% ethylene glycol, 5% polyvinylpyrrolidone and 0.3 M trehalose in a base solution, which had the same composition as for porcine embryo culture) for 10 or 20 minutes (10- or 20-min group) at room temperature. They were then dropped with approximately 4  $\mu$ L of vitrification solution into liquid nitrogen and were stored in liquid nitrogen. After storage, microdroplets containing tissue were transferred into warming solution (0.4 M trehalose in base solution) at 37°C for 2 minutes then consecutively transferred for 2-min periods into 0.2 M, 0.1 M, and 0.05 M trehalose in base solution at room temperature. A total of 30 tissue fragments were xenografted. After 120 days, sperm were recovered from the grafts from 2 out of 5 mice in the 10-min group and 1 of 5 mice in the 20-min group. The sperm recovery rate increased with time after grafting, being 4/5 and 3/5 mice on day 180 and 8/8 and 11/17 mice after 230–350 days in the 10- and 20-min groups, respectively. One out of 4 gilts that had received oocytes fertilized using sperm from the 10-min immersion group delivered 2 live piglets, and one of another 4 gilts from the 20-min group delivered 4 live piglets (Kaneko *et al.*, *PLOS ONE*, 2013).

In conclusion, these results demonstrate that sperm capable of promoting neonatal development can be obtained using xenografting of testicular tissues into mice, even after cryopreservation for a longer period.

## SIGNAL TRANSDUCTION DURING FERTILIZATION IN PIG OOCYTES WITH SPECIAL REGARD ON GENE PRESERVATION

Zoltan Machaty

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At fertilization in swine, sperm-oocyte fusion triggers a series of calcium oscillations in the ooplasm that is responsible for oocyte activation and subsequent embryo development. The oscillations are stimulated by the sperm-derived phospholipase C- $\xi$  (PLC-zeta) that hydrolyzes phosphatidylinositol 4,5-bisphosphate (PIP<sub>2</sub>) in the oocyte and thus generates repeated cycles of inositol 1,4,5-trisphosphate (InsP<sub>3</sub>), a crucial second messenger used in calcium signaling. InsP<sub>3</sub> then binds to its receptors on the surface of the endoplasmic reticulum and causes the release of calcium from the store into the cytoplasm. In turn, calcium is removed from the cytosol by calcium pumps: they load calcium back into the store or move it out of the cell. The repetitive release and re-uptake of calcium by the intracellular stores generate the prolonged calcium oscillations that last for several hours and are believed to be the key signal for oocyte activation. The extrusion of calcium from the cell by the plasma membrane calcium pumps may be so significant that an influx of calcium from the extracellular space becomes necessary to compensate for the loss. It was demonstrated that during the sperm-induced calcium oscillations, a calcium influx is stimulated after each calcium rise. The entry of calcium seems to be under the control of the intracellular stores, i.e. it is stimulated by the release of the stored calcium. The components of this store-operated calcium entry pathway have been identified recently. STIM1 is a protein that senses the filling status of the stores and after calcium release it delivers the empty signal to the oolemma. Orai1 is a channel in the plasma membrane; when it is activated by STIM1 it lets extracellular calcium flow into the cytoplasm. In pig oocytes the communication between the two proteins seems to be important to generate store-operated calcium entry and sustain the train of calcium spikes during fertilization. Assisted reproductive technologies have immense potentials in gene preservation programs and a better understanding of the mechanisms that control fertilization is a pre-requisite for the enhancement of the efficiency of such technologies. Providing the right molecules in an appropriate milieu for the gametes and preimplantation embryos helps to increase the production of good quality embryos in the laboratory that offer great benefits in preserving national genetic resources.

## EMBRYO VIABILITY AND OFFSPRING DEVELOPMENT IN IBERIAN PIGS

Antonio Gonzalez-Bulnes

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The Iberian pig, like other Mediterranean fatty breeds, has been traditionally managed in extensive production systems, where pigs are exposed to continuous changes in food availability throughout the year. Thus, the breed has developed a *thrifty genotype* for accommodation to seasonal cycles of feasting and famine and the animals store excess fat during food abundance, which enables survival during scarcity periods. Iberian pigs show a high voluntary food intake and a great trend for fat accumulation and obesity when food is in excess. This abundance of fat causes an increased secretion of leptin when compared to lean breeds. However, the Iberian pig has a gene polymorphism of the *leptin receptor (LEPR)* with effects on food intake, body weight and fat deposition. Thus, Iberian *LEPR* alleles increase insatiability and pigs become more and more obese in abundance of food. This situation, also identified in obese human beings, is so-called *leptin resistance*. Polymorphisms for genes regulating *LEPR* have been linked to reproductive disorders in humans. Similarly, the Iberian pig is also characterized by a lower reproductive efficiency, mainly a lower prolificacy, than lean breeds. Different studies suggest that embryo viability is a more important factor than ovulation for limiting prolificacy of the Iberian genotype, due to deficiencies in implantation, placentation and embryo development which may be related to the proper syndrome of *leptin resistance*. Pregnancy in Iberian pigs is also affected by later deficiencies in placental function and, thus, in the supply of nutrients and oxygen to the embryo/foetus, causing deficiencies in embryo growth in a process named as intrauterine growth retardation (IUGR). Piglets affected by IUGR are predisposed to high neonatal morbidity and mortality rates, with early death or life-long alterations in their development, health and welfare.

## THE EFFECT OF PROTEIN CONCENTRATION IN DIET ON AGE OF ATTAINMENT OF PUBERTY AND LIBIDO TEST OF INDIGENOUS KOLBROEK BOARS

T.R. Netshirovha<sup>1,2</sup>, D.O. Umesiobi<sup>2</sup>, M.B. Masenya<sup>1</sup>, M.L. Mphaphathi<sup>1</sup>, T.L. Nedambale<sup>2\*</sup>

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The objectives of the study were to determine the effect of different protein intakes on boar libido, gonadal measurements, plasma hormone concentrations and reaction time in Kolbroek boars. A total of 14 Kolbroek boars aged 5 months were used in this study. Boars were randomly allocated to three protein diets comprising of 10, 13 and 16% crude protein. The bodyweight, backfat thickness, boar libido, plasma hormone concentrations and reaction time were measured from 5-8 months of age. Gonadal measurements increased with age, irrespective of the protein inclusions. Bodyweight, gonadal measurements and testosterone concentrations were not affected by different protein inclusions. The data were analyzed using the GLM (General Linear Model procedure) of SAS, 2000. However, boars fed the control diet required more reaction time (154 seconds) compared with boars fed the low (101 seconds) and high (136 seconds) protein diets. In conclusion, protein inclusion levels had no significant effect on the bodyweight, testosterone levels and gonadal measurements. Furthermore, it is recommended that 16% protein inclusion should not be fed due to the price of protein.

Key words: Kolbroek boars, testosterone, libido, puberty and protein.

## **CURRENT ASPECTS OF THAI FATTY PIG**

Narut Thanantong

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Nakhon Pathom, 73140 Thailand*

Fatty pigs in Thailand were originated back when the Chinese government presented HRH Princess Maha Chakri Sirindhorn with Meishan pigs in 1981 and 1994. The Meishan pigs were raised, bred and also crossbred with other commercial-breed pigs (especially Duroc) by the Department of Livestock Development of Thailand and the offspring have been distributed to many rural areas of Thailand. Nowadays, the majority of fatty pigs are raised in a backyard in a small-scale subsistence production type. Fatty pigs were supplied to local niche markets mostly as piglets. Due to the lack of experience and education of farmers, health and production management of fatty pig was considered to be poor as there was inbreeding (mating of boars or sows with their own progenies) observed. Virus infection and intestinal parasites were also reported in fatty pigs. Since Thailand is still suffered from pork export banned and the niche markets are mainly for nearby local markets, this restricts the improvement of Thai fatty pig industry. Thai general public needed to be aware of the difference between pork quality of fatty pigs and commercial-breed pigs to create a bigger demand for fatty pigs. Then the improvement of production and a larger scale of fatty pig industry will be followed.

## EUROPEAN FEEDING STRATEGIES IN FATTY PIG PRODUCTION

Miklós Mézes

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Fatty pigs have different requirements for nutrients because of lower growth rate and higher rate of fat deposition, in particular more intramuscular fat, than intensive pig genotypes. Intramuscular fat content has primary importance for the organoleptic traits of meat, more intramuscular fat resulted better organoleptic quality. Therefore different feeding strategies should be use for improving meat quality and more profitable production of fatty pigs. There are three main strategies in Europe with different advantages and weaknesses.

The first is the so-called *extensive feeding*, where pigs are kept on pasture during the whole year. No supplementary feeds are given during the vegetation period only during winter, when usually dried/fermented forages and grains are given. The exception is the feeding of lactating sows and piglets which are usually receive supplementary feeds, cereal grains (sows) and heat-treated grain mixture or commercial started diets (piglets). The main advantage of this method is the low feeding cost and good meat quality, but weaknesses are low productivity, extreme long fattening period and high percentage of losses. A special type of extensive feeding is use in Spain for fattening the Iberian pigs, and in the In the New Forest in southern England. The extensive feeding is based on acorn in Spain during the last six months, and acorns and beechnuts during the last two months in England during the late phase of fattening.

The second is the so-called *semi-intensive feeding* technology, where gilts, barrows and breeding pigs (sows and hogs) are kept on pasture during the whole year with supplementary feeding out of vegetation period. Weaned piglets (up to about 25 kg) and fattening pigs are fed with supplementary feeds, in particular grains and fat supplements. The main advantage of this method is higher productivity with the same meat quality such as extensive feeding, but the losses are also high and fattening period also long.

The third is the so-called *intensive feeding* strategy where the pigs fed with commercial mixture with a nutrient content demand the predicted requirement of the particular group. The main advantage of this method is higher productivity than the previous ones, but quality of meat is depends on the nutrient content of feed during fattening. Length of the fattening period can be modifying with the change of energy and/or protein density of the diets, because fatty pigs requires higher energy and much less protein content diet over 60-70 kg body weight that intensive genotypes.

## FERTILITY OF FATTY PIGS IN AUSTRIA - A FIELD DATA STUDY

Berger, B., Schipflinger, F., Schimps, S.

The Austrian conservation program for rare breeds of farm animals has included Mangalica and Turopolje pigs since 2001. Most of the breeders own only 1 to 4 sows, farms with more than 10 brood sows are very rare. As a rule natural mating is used and most of the farms keep at least 1 boar. The herdbook is kept online and accessible for registered breeders and the breeding organisation since 2007. Only purebred litters are registered. Evaluation routines are integrated into the software as well as the calculation of population genetics data.

352 Mangalitzas and 423 Turopolje farrowings on 133 farms were registered from 2008 to 2012. Farrowing and weaning data were related to the genetic background of the breeding sows.

The mean numbers of litter size and weaned piglets per litter are consistent with international literature. Piglet losses until weaning are low although the pigs are kept in very simple sheds without any protection against cold or smothering by the sow. This may be due to the high vitality and good mothering abilities of fatty pig breeds. Farm structure and experience of the breeder strongly influence the number of born/weaned piglets per litter.

## RESEARCH INSTITUTE OF ANIMAL BREEDING AND NUTRITION IN NATIONAL SWINE STRATEGY

József Rátky, Hedvig Fébel, András Nyíri, Attila Zsolnai, István Egerszegi

The National Swine Strategy (NSS) of the Hungarian Government was published in 2012 with general goal to increase the Hungarian pig population to cc 6 million heads in other words to double the presently registered stock. Experts agree that this number should be achieved by revitalization of SMEs of pig farming without bothering or making harms in conditions of professional industrial pig sector using international breeds and hybrids of top reproductive and productive capacity. NSS declared the intention to promote and propagate the Hungarian breeds first of all the Hungarian Large White (HLW), Hungarian Landrace (HL), Hungahib 39 (H39), their different crossings as well as the icon of Hungarian pig breeding i.e. the Mangalica. Nevertheless HLW and HL have slightly less reproductive performance and maybe a bit less productivity they produce high quality for fresh pork and moreover for traditional Hungarian processed products. In this ranking Mangalica is undoubtedly the premium breed however HL and HLW are overcoming most modern commercial hybrids. Since Hungarian breeds were getting in a rather remote position during recent 20 years R&D is included in NSS to upgrade the relevant knowledge and to further improve the Hungarian genetic resources.

8.6 million € was allocated for different chapters of NSS in 2013 where we underline the mentioned R&D and investment project i.e. Fattening Performance Test Station.

Scientific programs have been started at Research Institute for Animal Breeding and Nutrition (ATK): 1- Replacement of import soy beans with domestic protein sources (by-products) in swine nutrition. 2 - Survey of genetic background of Hungarian pig population. 3 - Improvement of reproductive potential in HLW and HL breeds. 4 - Survey of meat quality and intramuscular fat content in Hungarian pig population. 5 - Identification of Mangalica products by „field test”. 6 - Organization of 2nd Fatty Pig conference.

Based on recent experiments we recommend the formation of strategic fodder basis, current and alternative energy- and protein sources build in production and „branding” pure cereals vs. „others” fed pigs. After the commencement of genetic survey we underline the importance of traditional breeding work, complex selection, improvement of reproduction and lifetime performance, artificial insemination. Seems to be realistic aim to improve the litter size by 1.5 piglet in a short interval.

The Fattening Test Station will be opened at ATK in March 2014 where different genetic values can be compared under standardized circumstances. It is a necessary precondition to ensure scientific evidences in the background of the productivity of the Hungarian swine genetic resources.

## PIG BREEDING IN UPLAND RURAL AREA OF THE LAO PDR

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Pig production is the most significant part of smallholder livestock management in Laos. In 2007, pork was second consumed meat, with an estimated 11.55 kg eaten per person. Nowadays importance of food security is increasing with demand for pig meat consumption. However, the supply of locally produced pig meat has not been able to meet this demand. Consequently importation of pre-fattened market ready pigs from neighboring country is increasing. Per capita pig density is the highest in the northern mountainous region and in the southern region in the mountainous areas along the border with Vietnam. Among the various ethnic groups, pig ownership is highest among the Hmong people with 73% of households raising pigs, which compares to 64% for Khmu people and 38% for Lao loum people. At the village level, improved efficiency of native pig production throughout the country is a significant income of livelihood security, reducing poverty and gene pool conservation. The aim of the study is to give a small overview about the phenotypic characteristics of Moo Lat pig and swine breeding of mountainous area of Lao PDR.

Recently phenotypic characterization was done of the breeds; however, it did not meet fully with the guidelines of FAO (2012). We started the work last year to upgrade previously collected data. Altogether 74 Moo Lat pigs were included in the preliminary investigation. Measurements were taken by mobile scale and measurement tape as described by FAO (2012). The following data were noticed: sex, age (year), body weight, body length, heart girth, height at withers, ear length, tail length, pelvic width and hock circumference.

Animals were grouped by age to about one, two and >3 years old in both gender. In this preliminary study boars were described with higher body weight, heart girth and hock circumference in all groups compared to females. Whereas females had a longer body length in each groups and had wider pelvic width in groups less than 3 years of age. The measurements should be continued to give a precise description of this breed.

## **VERTICAL PRODUCTION SYSTEM IN A HUNGARIAN SMALL SCALE MANGALICA FARM**

Zoltán Kövér

Zoltán Kövér, a small scale Mangalica farmer from small town Kaba, Eastern Hungary introduced his enterprise.

Typical family farm is breeding, fattening, processing Mangalica and at regional market selling its' products, respectively.

They have pig farm very long ago with special emphasis on Mangalica from 2005. Number of population was increased; genetic value was improved in the first couple of years.

They decided to produce F1 pigs with higher reproductive and productive ability and better pork quality.

They have 80 sows and the offspring at the farm. Feeding is based on high quality grain with much green fodder. Housing of breeding animals and fattening pigs is extensive and intensive, respectively.

They began processing and selling of products in 2010 with significant increase of profit. Portfolio contains 10 % fresh pork, 25 % processed products and 65 % fattened pigs for Spanish export. Export is arranged by the integrated by Olmos Tóth Ltd. Income is shared upon 15 % fresh pork, 35 to 40 % processed product and 45 % fattened pigs.

They underline the special importance of Association of Hungarian Mangalica Breeders in organization of breeding, marketing including different festivals and other events.

For the future they have vision to increase the existing portfolio and improve rural tourism to complete their multifunctional agriculture activity.

## HIGH EXPRESSION OF DECOY RECEPTOR-3 IN GRANULOSA CELLS OF MANGALICA PIG OVARIES

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More than 99% of follicles undergo atresia during follicular development and growth. Follicular atresia is predominantly regulated by granulosa cell apoptosis. However, the regulation mechanisms of apoptosis in granulosa cells has not been revealed. We examined the changes in expression levels of decoy receptor-3 (DcR3) in porcine granulosa cells during follicular atresia. DcR3 mRNA and protein levels were determined by the quantitative real time reverse transcription polymerase chain reaction (RT-PCR) and Western blot techniques, respectively. Levels of DcR3 mRNA and protein were markedly increased in granulosa cells prepared from healthy follicles compared to those of atretic follicles. *In situ* hybridization and immunohistochemical staining revealed that mRNA and protein of DcR3 were present in the granulosa cells. Strong staining was found in the granulosa cells of healthy follicles, but negative or traces staining was noted in those of atretic follicles. Then, to confirm the anti-apoptotic activity of DcR3 in granulosa cells, we examined the effect of neutralizing against DcR3 by antibody on apoptosis using primary cultured cells of ovarian granulosa cells. When DcR3 was neutralized, a significant increase in the apoptotic cell rate was noted. These present results indicate that DcR3 appear to be apoptosis inhibiting factor in granulosa cells during follicular atresia and to play antiapoptotic roles.

Compared with DcR3 expression levels in granulosa cells of the ovaries of Mangalica pig, a Hungarian native pig and shows small litter size, in the expression levels in that of commercial breed (Landrace, Large Yorkshire and Duroc) was characterized by very low, suggesting that follicular granulosa cells are easily die in Mangalica ovaries. Moreover, because low DcR3 has a role in enhancing the apoptosis in virus infected cells, low expression of DcR3 in Mangalica pig may associated with high resistance to viral infectious diseases.

## PHYSIOLOGICAL EFFECTS OF MANGALICA MEAT

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Today, nutrition is not only about the persons biological needs, but also it is influenced by economy, gastronomic and cultural habits. Inadequate nutrition can lead to numerous diseases or pathological conditions. At the same time, healthy nutrition based on scientific evidence decreases the risk of many diseases.

A functional food looks like a normal food (is not a capsule or powder) but bears an additional function (or by containing new ingredients or by containing more from known ingredients).

Pork meat is very popular in the world. The 38% of the eaten protein comes from pork meat in the world. The Hungarian Mangalica has a special meat composition, bacon rate and quality, because it has more fat, but a higher ratio of polyunsaturated fatty acids (PUFA) to another pig types and a more favourable balance between n-6 and n-3 PUFA. Mangalica meat contains 12-16% less saturated fatty acids and 8-10% more unsaturated fatty acids like white pigs. The Mangalica meat contains a large number of vitamins, for instance Vitamin B1, pantothenic acid, cyanocobalamin or niacin and a large variety of minerals, for example iron, zinc, magnesium and phosphor.

In our functional food studies we investigated the effects of Mangalica bacon on the human organism in certain pathology or disease conditions. Mangalica bacon improves cholecystokinin secretion, which results in a large number of positive effects in a human body, for example an endogenous insulin sensitizing mechanism. We studied also the effects of consuming Mangalica bacon on gallbladder hypomotility in pregnancy and on hearing loss in elderly.

## TRACEABILITY FROM BARN TO CONSUMER

Adrienn Micsinai

Traceability is much of a buzz word among the food and feed business operators. The European Union has brought several legislative measures since past food incidents have demonstrated that being able to trace food and feed throughout the food chain is of prime importance for the protection of public health and consumers' interests. Traceability helps to target withdrawal and recall of food, enable consumers to be provided with accurate information and thus maintaining consumer confidence and fair trading among operators, and to facilitate risk assessment by control authorities.

Regulation 178/2002 of the European Parliament and of the Council, Article 18 created a new general obligation for food business operators by having to identify the „one step back – one step forward“ operators in the chain, as well as keeping records for internal traceability. The scope of the regulation does not only include strictly the food business operators – it includes all stages from the food and feed chain: from primary production (harvests, animal production) to food or feed processing, distribution and supply, including brokers; though the regulation pinpoints the food business operation as the best placed entity to devise a safe system for ensuring food safety. However not only this traceability regulation applies in the EU, there are several specific traceability system for certain sectors or products, such as the Beef Labelling or the GMO scheme.

With regard to foodstuffs of animal origin, the EU has adopted more specific rules on the information to be kept in the traceability systems described the Commission Implementing Regulation 931/2011. However, the identification of animals at an individual or herd level is – as done in the Beef Labelling Scheme - is still not required.

Labelling of animals at a farm level in order to ensure identification and traceability is done primarily by three methods: physical tags, electronic identification (EID), or feature identification systems. It is widely accepted, that physical tags are prone to loss and require paperwork; on the other hand, EID systems are more expensive, but they support electronic data transfer (EDT) and thus are easier to handle once the investment is done. Moreover, EID/EDT supports official enforcement, just as the feature identification systems, such as DNA profiling. This last area has developed much in the last decade, with the major farm animal genome projects mostly completed and services available to type the animals to individual level. However, these methods only pay off in ensuring the traceability of premium animal products.

**Abstracts**

Posters

## DEVELOPMENT OF IMMUNOCASTRATION PROTOCOLS FOR PUREBRED IBERIAN GILTS REARED IN EXTENSIVE SYSTEMS

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Iberian pigs are raised in Spain in extensive, free-ranging systems in which males and females are surgically castrated to avoid several management problems. However, the new animal welfare regulations restrict female surgical castration. The objectives of the present study were to develop two feasible immunocastration protocols, one (early) for pre-pubertal gilts and another (late) for adult females at the beginning of the finishing phase, to prevent estrous cyclicity up to slaughter, which typically takes place at an older age and heavy weight for extensively reared Iberian pigs. Late-Immunocastrated Females (**L-ICF**; 2 experiments: n=28 and n=26) were immunized with Improvac<sup>TM</sup> (Zoetis-Pfizer) at 11, 12 and 14 months of age and were slaughtered at 16 months of age. Early-Immunocastrated Females (**E-ICF**; 2 experiments: n=6 and n=24) were immunized at 4.5, 5.5 and 9 months of age and were slaughtered also at 16 months of age. Intact Females were used as controls. Estradiol and/or progesterone blood levels and post-mortem utero-ovarian measurements indicated ovarian and estrous cyclicity in Control gilts and acyclicity in all (100%) Treated gilts, whose reproductive tracts remained (E-ICF) or became (L-ICF) immature until slaughter. In conclusion, both of these 3-dose, pre-pubertal and late, immunization protocols offer highly effective alternatives to surgical castration for the prevention of estrus in extensively-reared Iberian gilts. In addition, the early immunocastration protocol, with no need for separation of sexes before immunization, would simplify herd management in extensive systems.

Keywords: Iberian pig, reproduction, GnRH inhibition, Improvac, female, puberty

## **THE EFFECTS OF HYBRIDIZATION ON FATTENING, CARCASS TRAITS AND MEAT QUALITY OF LITHUANIAN WHITE PIGS**

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The aim of the present study was: to investigate the reproductive performance of purebred Lithuanian White pigs and their crossings with Finnish Landrace boars, to determine the development of body and internals, fattening performance and meat percentage of Lithuanian White pigs and their crossbreds, to analyze the influence of Finnish Landrace boars on physicochemical indicators of meat and its bouillon. Two groups of pigs were formed at the agricultural partnership. Group 1 – purebred Lithuanian White (LW), group 2 – Lithuanian White and Finnish Landrace crossbreds (LWxFL). The reproductive performance and index of reproductive traits of sows in all groups have been studied. Control fattening of pigs has been carried out, at the end of which body conformation traits of pigs have been analyzed. Backfat thickness in vivo measurements (FAT 1, FAT 2, mm) and lean meat content (%) for 100 kg pigs were determined with the apparatus PIGLOG 105. Pigs of 100 kg weight were delivered to meat processing plants for control slaughtering and carcass evaluation. The physicochemical indicators of meat and content of fatty acids were determined at the Analytical Laboratory of the Institute of Animal Science of LUHS.

Lithuanian White pigs were distinguished by the highest reproductive performance, i. e. these pigs had the highest litter size (10.6 pigs), number of pigs at 21 (10.5 pigs) and 60 (10.2 pigs) days, weaning weight (159.3 kg) and survival rate of piglets (93.3 %). Boars of Finnish Landraces genotype had a negative influence on sow fertility, i. e. the litter size has decreased from 0.7 ( $P<0.025$ ) piglets in comparison with the Lithuanian Whites. Crossing of Lithuanian Whites with Finnish Landrace boars had a positive effect on fattening performance of first generation crossbreds. LWxFL crossbreds gained daily, respectively, by 43 g more than the control (LW) group of pigs ( $P<0.001$ ). The boars of experimental group had a positive influence on the carcass traits of crossbreds: ham weight was higher by 7.8% ( $P<0.001$ ), backfat thickness at 6-7th rib was lower by 3.1 cm ( $P<0.01$ ) compared with the control (LW) group. Ultrasonic measurements with PIGLOG 105 indicated that crossing with boars of Finnish Landrace genotype increased the lean meat content of Lithuanian White progeny by 2.1 % ( $P<0.05$ ). Meat quality of LWxFL crossbred pigs was higher than that of Lithuanian Whites. The protein content in the meat of these crossbreds was by 1.3 higher. The higher melting temperature of fat (42.6 °C,  $P<0.001$ ) was determined for the control (LW) group of pigs. The meat of LWxFL crossbreds received the best sensory evaluation scores, especially for flavour and aroma. Their meat was scored by 0.7 higher compared with the Lithuanian Whites ( $P<0.025$ ).

## THE TIMING OF THE FIRST MITOTIC CLEAVAGE REFLECTS NORMALITY OF PORCINE EMBRYOS PRODUCED BY IVF

T Somfai, S Haraguchi, TQ Dang-Nguyen, T Nagai, S Bodo, K Kikuchi

In vitro fertilization (IVF) technology is effective for the utilization of porcine genetic resources cryopreserved in gene banks. However, selection of high quality embryos for research or piglet production is still a difficult task. Our previous studies have revealed a correlation between an early first cleavage and high developmental competence in IVF-derived porcine embryos (Dang-Nguyen et al., 2010). However, the factors contributing to the high competence of early cleaving embryos remained unclear. Furthermore, direct cleavage of fertilized oocytes to 3-4 blastomeres is believed to be associated with polyspermy and therefore low developmental competence (Funahashi, 2003). However, the relationship between cleavage timing and the onset of such cleavage type is not known. In the present study we compared early and late cleaving porcine embryos in terms of cleavage normality as measured by the numbers of resultant blastomeres after the first embryonic cleavage, the absence of fragments (anuclear blastomeres) and mitochondrial distribution in blastomeres. Porcine zygotes were produced by in vitro maturation (IVM) and IVF of follicular oocytes collected from slaughtered gilts according to standard protocol (Kikuchi et al., 2002) and were in vitro cultured. At 30, 40 and 50 h post IVF (hpi) newly cleaved embryos were harvested, subjected to a simultaneous staining mitochondria and DNA by MitoTracker Red CMXRos and Hoechst 33342 dyes, respectively. Stained embryos were investigated under a laser scanning confocal microscope. Four replications were performed. Data were analyzed by one-way ANOVA. After IVF, 56.2% of total oocytes finished their first cleavage at 30 hpi and additional 12.1% and 6.3% of oocytes cleaved 40 and 50 hpi, respectively. The frequency of newly cleaved embryos with abnormally high numbers (3-4) of blastomeres did not differ statistically at 30, 40 and 50 hpi (39.1%, 46.7% and 33.3 %, respectively). The frequency of newly cleaved embryos showing partial fragmentation was higher ( $P < 0.05$ ) in embryos having 3-4 blastomeres compared with those having 2-blastomeres at 30 h after IVF. Irrespective of cleavage types the frequency of fragmentation increased by late cleavage. At 30 hpi normal perinuclear mitochondrial distribution was observed in most blastomeres irrespective of blastomere numbers in embryos. However, in embryos cleaving at 40 and 50 hpi frequencies of embryos with blastomeres lacking perinuclear mitochondria tendentially increased, most prominently in those having 3-4 blastomeres. The results demonstrate that early embryonic cleavage is associated with reduced frequencies of fragmentation and normal organelle distribution in blastomeres. However, the onset of an abnormal cleavage directly to 3-4 blastomeres can not be predicted by cleavage timing. Selection of embryos with 2 blastomeres at 30 hpi is advised for embryo transfer or experimental purposes.

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## Notes



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