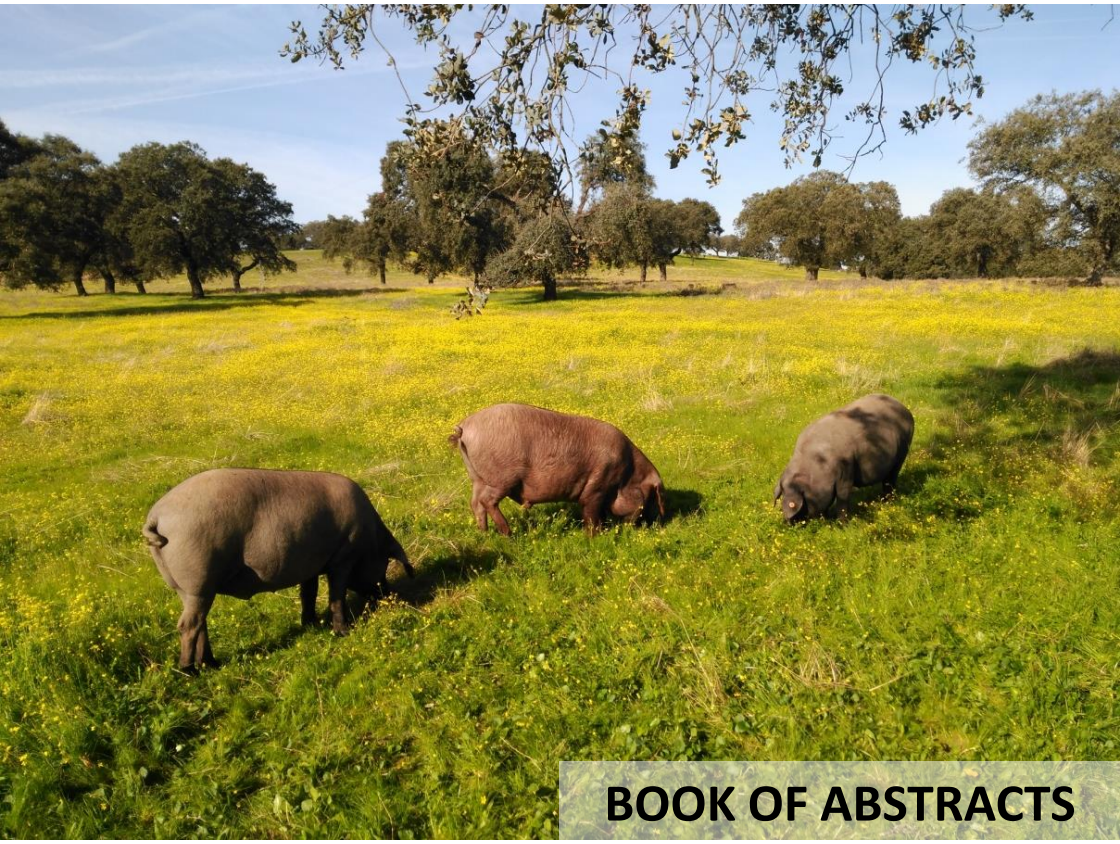
4th FATTY PIG

Science & Utilization International Conference

NOVEMBER 2017, Badajoz (SPAIN)



BOOK OF ABSTRACTS

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Instituto Nacional de Investigación y Tecnología Agraria y Alimentaria

4th Fatty Pig Science & Utilization International Conference

23-25 November, 2017, Badajoz (Spain)

BOOK OF ABSTRACTS

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Cover photographs. Description and credits:

- Front cover: Iberian pigs during *montanera* in the *dehesa*. From left to right, Retinto, Torbiscal and Lampiño strains. Javier García Gudiño (CICYTEX; IRTA).

- Back cover: Blond Mangalitza piglet and sow. Francisco I. Hernández García (CICYTEX).

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FOREWORD

Fatty pigs are old, autochthonous, rustic breeds well adapted to their environment that make an advantageous use of local natural resources and are highly appreciated as sources of traditional meat products, not only for their high sensorial quality, but also for being considered as an important part of national and regional heritage. Important fatty pig breed populations are found worldwide, from Japan to the Eastern and South-Eastern continental Asia, Europe, South Africa and Latin America.

These breeds are highly valuable genetic resources with a great potential for a high market value in some breeds and a highly prized quality standard in other cases, like the Iberian and Mangalica. However, they have been neglected in the past as meat producers when animal fat lost its value as a nutritional energy source. Later on, even their meat products became blamed as unhealthy and farmers lost their interest on these breeds due to their slower growth rate in comparison to modern, highly selected breeds.

Fortunately, the current interest of worldwide consumers for the high-quality of local fatty-pig products is favouring the recovery of some of their populations, although some of their less productive breeds and strains are still highly endangered. Paradoxically, this increasing demand for fatty-pig products is transforming the traditional extensive management of these breeds into more intensive production schemes, thus decreasing the sustainability and resilience of their production systems. Indeed, this intensification ignores the physiology of fatty breeds and their trend for adiposity and obesity, therefore rendering conventional extensive systems inadequate for the sustainable use of these breeds. In contrast, traditional extensive systems not only allow the sustainable use and welfare of the pigs and the quality and health benefits of their products, but also contribute to the sustainable use and preservation of the local ecosystems, therefore contributing to economical and societal sustainability of rural areas by increasing their profitability and business and employment opportunities, which mitigates the exodus to industrialized areas.

Nevertheless, fatty-pig production faces important technical challenges arising from their peculiar physiology, metabolism, growth

rate and behavioral and reproductive management. Fortunately, a bunch of Asian and European experts gathered in Hanoi, Vietnam in September 2009 and gave rise to a "Fatty Pig Group" to promote knowledge transfer and progress in this area, specially in relation to the European and Asian breeds. The first Fatty Pig Conference was held in 2011 in Hungary. Since then, these events have been held every two years in that country thanks to the enthusiastic endeavour of Prof. József Rátky, head researcher of the Hungarian NARIC-ATK research institute. Now these meetings evolved and start a new journey to spread the same enthusiasm all over the fatty-pig geographical range.

Therefore, the main objective of this conference is to congregate producers, technicians, researchers, policy makers and representatives of breeders associations, Denominations of Origin and Geographical Indications from various countries, thus encouraging the exchange of knowledge and expertise in order to optimize fatty-pig production systems and related industry, so their products become more profitable, healthier and environmentally and economically sustainable. In this regard, these meetings are intended for those involved in research, technological transfer, knowledge dissemination, animal production and meat product processing and marketing within this or related sectors.

ORGANIZING INSTITUTIONS

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Programme. 4th Fatty Pig International Conference

SCHEDULE

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<tr><td>10:00</td><td rowspan="2">Session 1 (oral communications)</td></tr>
<tr><td>11:00</td><td>Coffee</td></tr>
<tr><td></td><td>Coffee</td><td rowspan="2">Poster session (session 4)</td></tr>
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<tr><td>17:00</td><td>Coffee</td></tr>
<tr><td></td><td rowspan="2">Poster session (sessions 1,2 and 3)</td><td>Poster session (session 6)</td></tr>
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<tr><td>20:00</td><td rowspan="3">Tourist visit</td></tr>
<tr><td>21:00</td><td rowspan="2">Social Event: gala dinner and Monte Nevado awards ceremony</td></tr>
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</table>

PROGRAM

First day (Thursday, November 23rd)

8:30-9:30. Reception and registration

9:30-10:00. Welcome and opening session

10:00-11:30. Session 1. Production systems, natural resources and sustainability. Potential role in rural development

Chairs: *Luís Telo da Gama (PRT), Mercedes Izquierdo (ESP)*

10:00-10:30. **Keynote: S1OC01- *M. Čandek-Potokar*** (SVN)
Growth performance of local pig breeds – analytical review in the project TREASURE.

10:30-10:45. **S1OC02- *G. Zhenhua***
Min pigs show a higher tolerance to cold stress: an assessment in reproductionperspective.

10:45-11:00. **S1OC03- *S. García-Torres***
Characterization of meat quality in different Iberian pig lines finished in *montanera* system.

11:00-11:15. **S1OC04- *F. Thabethe***
Adaptation of finishing pigs to graded levels of *Vachellia tortilis* leaf meal diet.

11:15-11:30. **S1OC05- *F. I. Hernández-García***
Use of rice husk as welfare fiber during the premontanera feed-restriction period in Iberian pigs: effects on growth, behavior and body composition.

11:30-12:00. Coffee break

12:00-14:00. Session 2. Breeding and Genetics

Chairs: *Attila Zsolnai (HUN) Marcos Ramos (PT)*

12:00-12:30. **Keynote: S2OC01- *C. Óvilo*** *(ESP)*
Diversity across major and candidate genes in European local pig breeds.

12:30-12:45. **S2OC02- *A. J. Amaral***
Genome-wide screen of intramuscular fat in *Alentejano* pigs: uncovering the genetic basis of lipogenesis.

12:45-13:00. **S2OC03- *M. Bates***
British experience of genetic management of traditional pig breeds.

13:00-13:15. **S2OC04- *L. Di***
Genetic mechanism of *Min* pig elite germplasm characteristics.

13:15-13:30. **S2OC05- *Z. Shumin***
Breeding of Songliao Black pig and its industrial development.

13:30-13:45. **S2OC06- *V. A. Bâlteanu***
Exploring the genetic background of fatty *Mangalitza* pigs from Hungary and Romania and relationships with wild boars populations using a SNP-based approach.

13:45-14:00. **S2OC07- *N.Garrido***
The effect of genotype and feeding system in the expression of lipogenic genes in Iberian pig.

14:00h–15:00h. Lunch

15:00-17:15. Session 3.Physiology and Reproduction

Chairs: *Francisco I. Hernández-García (ESP), Rui Charneca (PRT)*

15:00-15:30. **Keynote: S3OC01- *J. Rátky*** (HUN)
Management effect on reproductive and productive capacity of *Mangalica* pigs.

15:30-15:45. **S3OC02- *M. Waehner***
Analysis of special influencing factors on the estrous behaviour and fertilzation in sows.

15:45-16:00. **S3OC03- *A. Vernunft***
Placental characteristics of Hungarian *Mangalica* and German Landrace sows and their relationships to fertility parameters.

16:00-16:15. **S3OC04- *M.V. Sanz-Fernández***
Effects of low birth weight on the immune function of Iberian piglets.

16:15-16:30. **S3OC05- *N. Bovula***
Inclusion levels of α-tocopherol supplementation on growth performance and testicular development of *Windsnyer* boars.

16:30-16:45. **S3OC06- *M. Vázquez-Gómez***
Effects of nutritional pregnancy management on carcass and meat features of offspring: Implications for the production of dry-cured products.

16:45-17:00. **S3OC07- *T.R. Netshirovha***

The effect of selenium and zinc supplementation on growth performance of finisher *Kolbroek* boars.

17:00-17:15. **S3OC08- *P. García-Casado***

New systems of seminal quality analysis.

17:15-18:40. Poster session

Chairs: *Rui Charneca (PRT), Luís Telo da Gama (PRT),*

Session 1

S1P01- J. García-Gudiño

Behaviour of the iberian pig during *montanera*.

S1P02- K. Mphofu

Evaluating the effects of different inclusion levels of spineless cactus on growth performance of growing *Windsnyer* pigs.

S1P03- V. Margeta

Productive traits of *Crna Slavonska* finishing pigs fed with acorn.

S1P04- J.M. Martins

The Ribatejano pig: a cross based on a fatty pig.

Session 2

S2P01- A. Arakawa

Genetic relationships among domestic pigs in East Asia and Europe.

S2P02- R. Benítez

Ham subcutaneous fat transcriptome in growing Iberian pigs fed oleic acid *vs*. carbohydrates supplemented diets.

S2P03- C. Caraballo

Genetic verification of F1 Duroc x Iberian crossbred boars.

S2P04- Y. Núñez

Placental expression of genes involved in antioxidant homeostasis and vascularization in Iberian pigs.

S2P05- M. Taniguchi

Comparison of gene expression regulation in pork carcasses differing in intramuscular fat content.

S2P06-A. M. Ramos

Development of genetic markers in the *Alentejano* pig breed: the SelectPorAl project.

S2P07-M. Izquierdo

The effect of Iberian genotype and feeding system on carcass composition of Iberian pigs.

Session 3

S3P01- A. Ishida

Effects of feeding brown rice on the performance of fattening pigs and lactating sows.

S3P02- L.G. Makhanya

Onset of puberty in *Kolbroek* gilts using hormonal assays.

18:40. Social event

20:00. Touristic visit and wine in Badajoz

Second day (Friday, November 24th)

9:00-11:00. Session 4. Meat quality and products

Chairs: *Benedicte Lebret (FRA),Maria Font (ESP)*

9:00-9:30. **Keynote: S4OC01- *C. Pugliese*** *(ITA)*

The Quality of Meat and Cured Meat Products in European fatty pigs.

9:30-9:45. **S4OC02- *M. Laranjo***

Effect of genotype and salt concentration on the quality of Portuguese traditional *paios*.

9:45-10:00. **S4OC03- *M. Font-i-Furnols***

Effect of the immunocastration protocols on ham composition evaluated with computed tomography.

10:00-10:15. **S4OC04- *E .González***

Low-protein diet for Duroc x Iberian crossbred pigs: influence on fatty acid composition of subcutaneous adipose tissue.

10:15-10:30. **S4OC05- *A*. *López-García***

Olive cake-based growing diet for *montanera* Iberian pigs: effects on meat quality traits.

10:45-11:00. **S4OC07- *R. Lizardo***

Development of a dynamic simulation model to evaluate the influence of feeding strategies on fatty acid composition of pigs.

11:00-11:20. Coffee

11:20-12:45. Poster session

S4P01- ***J. Almeida***

Quality of meat produced by Iberian and Large White x Landrace pigs finished intensively or in the "*dehesa*" system.

S4P02- ***M.C. Bressan***

Lipid profile of intramuscular fat in Iberian and F1 Large White x Landrace pigs finished intensively or in the "dehesa" system.

S4P03- ***L. Cachucho***

Characterization of carcass composition and meat quality traits of *Alentejano* pigs finished under free-range conditions - Preliminary results.

S4P04- ***A. Chiara***

Nitrates replacement with natural antioxidant in Cinta Senese semi-ripened salami.

S4P05- ***J. Dilme***

Consumers acceptability of innovative products from Majorcan Black pig enriched with vegetal ingredients.

S4P06- ***J.L. Duarte***

Breeding program for carcass and meat quality traits in a closed commercial population of Iberian sows using boars from the herdbook.

S4P07- ***A.L. Torrescusa***

Effect of smoking on the physicochemical characteristics of dry-cured Iberian loin.

S4P08- ***F.I. Hernández-García***

Effect of feeding management on the efficacy of long-term male immunocastration protocols specifically designed for Iberian pigs.

S4P09- ***J. García-Gudiño***

Effect of the immunocastration protocols on consumers' acceptability of fresh loin from Iberian pigs

S4P10- ***G. Kušec***

Differences in growth rates of muscle tissue and fat in ham, loins and shoulder between *Crna Slavonska* pigs from two rearing systems.

S4P11- ***M. Gispert***

Effect of restriction feeding on sensory quality of pork loins.

S4P012- ***C.N. Ncobela***

Response in carcass characteristics of *Windsnyer* pigs fed on inclusion levels of potato hash silage.

S4P13- ***D. Radojković***

Carcass quality and fatty acids profile of the fatteners of Swallow-belly *Mangalitsa* breed reared in outdoor system.

S4P14- ***Č. Radović***

Effect of castration method on growth rate of indigenous pig breed *Mangalitsa* Swallow Belly.

S4P15- ***R.Savić***

Fatty acids content of m. *Longissimus dorsi* of *Moravka* pigs.

S4P16- ***A.M.Trejo***

Optimization of a cryohistological technique to perform micro-morphometric analyses of intramuscular fat marbling in the Iberian pig.

S4P17- ***J.González***

Influence of feeding on performance and backfat FA composition of Iberian x Duroc pigs raised under heat stress conditions.

S4P18- ***M.J. Martín***

Colour stability during prolonged storage in different packaging conditions of dry fermented sausages from Iberian pork.

S4P19- ***J.M. García-Casco***

Low-protein diet for Iberian – Duroc crossbred pigs: effects on some meat quality traits (water holding capacity and collagen and myoglobin content).

S4P20- ***G. Amaro***

Characterization of the nutritional quality of m. Serratus ventralis from Iberian pigs of Valdesequera line under different production systems.

S4P21- ***M. Cabeza de Vaca***

Characterization of subcutaneous fat for different iberian pig lines reared in montanera system

12:45-14:00. Session 5. Technology of Reproduction

Chairs: *Klaus-Peter Brüssow (DEU) and Lucky Nedambale (ZAF)*

12:45-13:15. **Keynote I:S5OC01-*N. Manabe*** *(JPN)*
Characteristic expression of BH3-interacting domain death agonist (BID) and Bcl2-associated X protein (BAX) in follicular granulosa cells of *Mangalica* ovaries.

13:15-13:45. **Keynote II: S5OC02-*T. Somfai*** *(JPN)*
Current status of oocyte cryopreservation for gene banking in pigs.

13:45-14:00. **S5OC03- *K.P. Brüssow***
Application of reproductive methods in fatty pigs.

14:00-15:00. Lunch

15:00-15:45. Session 5 *(cont.)*.Technology of Reproduction

Chairs: *Klaus-Peter Brüssow (DEU) and Lucky Nedambale (ZAF)*

15:00-15:15. **S5OC04- *T.L. Nedambale***
Effect of protein in testicular morphology of *Kolbroek* boars.

15:15-15:30.**S5OC05- *T. Páble***
Reproductive characterization of a native pig breed (*Moo Lat*) in Laos.

15:30-15:45. **S5OC06- *K. Kikuchi***
Recent progress on cryopreservation and utilization of testicular tissues for pig reproduction.

15:45-17:00. Session 6. Nutrition and new technologies

Chairs: *Olga Moreira (PRT) and Jose M. Martins (PRT)*

15:45-16:15. **Keynote: S6OC01- *R. Nieto*** *(ESP)*
Nutritional and physiological characteristics of Iberian pigs as an example of fatty pig breed.

16:15-16:30. **S6OC02- *B. Lebret***
Molecular biomarkers as predictors of sensory and technological pork quality.

16:30-16:45. **S6OC03- *A. Martín-Gómez***
Headspace-gas chromatography-ion mobility spectrometry to avoid labelling fraud in Iberian ham samples.

16:45-17:00. **S6OC04- *R. Hochegger***
Food authenticity - species identification in an official food control laboratory.

17:00–17:20. Coffee

17:20-17:45. Poster session

Session 6

S6P01- *A. Poto*
Characteristics of the carcass and meat of the *Chato Murciano* pig fed with carob bean (*Ceratonia siliqua*).

S6P02- *A. Poto*
Comparative study of the carcass and meat quality of the chato murciano pig fed with commercial fodder versus 15% carob bean (Ceratonia siliqua).

S6P03- *O. Moreira*
Malhado de Alcobaça pig breed: metabolic characteristics, growth performance and carcass traits.

S6P04- *W.L. García-Jiménez*
Effect of the oral administration of probiotics and vitamin D supplements in Iberian pigs.

S6P05- G.Amaro-Blanco
Preservation of sliced Iberian dry-cured shoulder using high hydrostatic pressure and an active packaging of olive leaf extract.

17:45-18:45. Session 7. Impact of policy onpremium pork production and future tasks in fatty-pig applied science: round table discussion

Chair: *Antonio González-Bulnes (ESP)*

17:30-17:45. **Keynote: S7OC01- *C. López-Bote*** (ESP)
Iberian pig niche market.

17:45:18:00. **Keynote: S7OC02- *P. Tóth*** (HUN)

18:00-18:15. **Keynote:S7OC03- *E. Diéguez*** (ESP)
Can science save fatty pig?.

18:15-18:30. **Keynote: S7OC04-Xinting Xao** (INTERPORC)

18:30-18:45. **Keynote: S7OC05- *A. González- Bulnes*** (ESP)
Future tasks in fatty pig applied science.

18:30-18:45. **Discussion**

21:30. Social Event: gala dinner and *Monte Nevado* awards ceremony

Third day (Saturday, November 25th)

09:00. Full-day technical tour, including a visit to an Iberian farm and lunch

14:00. Return to the hotel

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SESSION 1. PRODUCTION SYSTEMS, NATURAL RESOURCES AND SUSTAINABILITY. POTENTIAL ROLE IN RURAL DEVELOPMENT.

SESSION 2. BREEDING AND GENETICS

SESSION 3. PHYSIOLOGY AND REPRODUCTION

SESSION 4. MEAT QUALITY AND PRODUCTS

SESSION 6. NUTRITION AND NEW TECHNOLOGIES

Session 1. Production Systems, natural resources and sustainability. Potential role in Rural Development.

GROWTH PERFORMANCE OF LOCAL PIG BREEDS – ANALYTICAL REVIEW IN THE PROJECT TREASURE (S1OC01)

M. Čandek-Potokar, N. Batorek Lukač, U. Tomažin, R. Nieto & TREASURE Consortium

To evaluate performance and growth potential of local pig breeds involved in H2020 project TREASURE (www.treasure.kis.si), data on average daily gain (ADG) was collected from the literature. Average growth rates reported for local pig breeds are generally lower than those of modern, selected breeds used in intensive farming. In the postnatal phase (lactation), ADG of local pig breeds is comparable with values of modern breeds (217±47 g/day); however it should be noted that lactation is longer (47.2±9.9 days) and birthweight lower (1.2±0.2 kg). The reported ADG in the growing phase (<30 kg) is somewhat lower compared to modern pigs (336±89 g/day), whereas fattening phases are characterised by considerably lower ADG (449-567 g/day depending on phase), but also by big heterogeneity (spanning from 85-1085 g/day), in line with different systems and feeding levels. Typically Iberíco and Alentejano pigs have smaller ADG in early than late fattening which corroborates with their typical production system, i.e. restricted (recría) in early and ad libitum feeding in late fattening (montanera). However, in other local pig breeds similar or higher ADG in early than late fattening has been observed, implying restricted feeding in the later phases. As shown for several local pig breeds, relatively high ADG can be attained (≈1000 g/day) but leading also to substantial fat deposition. As growth is directly related to energy and nutrient supply, data on average daily feed intake (ADFI) was analysed and showed that reported ADFI roughly matched the expected/theoretical values in growing and early fattening phase, whereas ADFI was lower than expected in the late fattening phases. With ad libitum feeding high ADFI could be observed (late fattening ≈6 kg/pig/day) denoting high intake capacity of these non-selected breeds, a trait which seems to be reduced in modern breeds selected for lean growth. The survey (over 200 references) revealed great variability in terms of the availability and quality of information. A big part of collected studies simulated practical conditions of the production systems used, and only a small part of them allows a rough estimation of growth potential (and consequently infer nutritional requirements) which is important for developing and

optimising the production systems for sustainable use of local pig breeds in agricultural production.

Key words: growth performance; pig; autochthonous breeds; review

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 634476 (Project acronym: TREASURE). The content of this paper reflects only the author's view and the European Union Agency is not responsible for any use that may be made of the information it contains.

MIN PIGS SHOW A HIGHER TOLERANCE TO COLD STRESS: AN ASSESSMENT IN REPRODUCTION PERSPECTIVE (S1OC02)

G. Zhenhua, Y. Yunchun #, L.Di †, Md. Saiful, L. Lei, W. Wentao, Z. Dongjie, P. Fugang, F. Bo, W. Liang, L. Ziguang

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Raising Min Pigs (MPs) in northern China is challenging, because of harsh environmental conditions in winter. We hypothesise that MPs can tolerate cold stress better than Large White Pigs (LWPs) and their oocyte competence is particularly protected. Over a period of 3 years, we studied multiple cohorts of MPs and LWPs under different environmental conditions. We used follistatin (FST) serum levels as a marker for swine oocytes competence. We also collected oocytes from the swine and measured their maturation rate, cleavage rate and blastocyst rate. Lastly, we measured mRNA expression in ovary and longissimus dorsi for the genes FST, LHR and CIRP. Under cold stress, serum follistatin concentrations of both LWPs and MPs were markedly increased, more so in LWPs than in MPs. However, oocyte competence was found to be unaffected by cold stress in MPs. In a separate group of LWPs, we found lower oocyte competence in samples collected in winter than in the other seasons. Interestingly, follistatin levels in the follicular fluid of MPs showed no change with cold stress, serum follistatin levels were elevated in both boars and sows. Gene expression analysis showed a significant reduction in FST, LHR, and CIRP expression under cold stress in longissimus dorsi, but not in the ovaries. We find that MPs are better able to maintain oocyte competence under cold stress that may be due to improved regulation of follistatin in follicular

fluid and it appears likely an adaptation to the harsh conditions that MPs face under domestication in northern China.

Key Words: Cumulus-oocyte Complexes, Follistatin, Large White Pig, Min Pig, Season

CHARACTERIZATION OF MEAT QUALITY IN DIFFERENT IBERIAN PIG LINES REARED IN MONTANERA SYSTEM (S1OC03)

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Despite the large information reported by several authors about the quality of meat and meat products from Iberian pig, the results suggest a lack of uniformity on meat quality. Genetic variability of Iberian lines could be one of the reasons behind these differences. Due to Iberian pig breed it is composed by several genetic lines, with differential characteristics.

In order to study the effect of three Iberian pig lines (Lampiño, Torbiscal and Valdesequera) in meat quality of *Longissimus dorsi* (LD), 36 pure breed animals (12 per line) were free rearing under Montanera system (typical free-range system from SW of Spain with a feeding based on acorns and herbage) and the animals were slaughtered at 150±10 kg live weight. The *Longissimus dorsi* muscles (LD) were removed and pH, colour, nutritive composition, Vitamin E content, fatty acid profile and texture characteristicts were analyzed.

The LD muscle from Lampiño showed significantly higher pH values than Torbiscal. The highest CIE a* and C* and the lowest H values in LD were found in Valdesequera line. Moisture, protein and α-tocopherol contents were not significantly affected by the line, but the highest contents of intramuscular fat (IFM) were linked to animals of Valdesequera, and Torbiscal line had higher γ-tocopherol contents than Lampiño. Fatty acid profiles from Valdesequera pigs showed the significantly highest oleic acid (C18:1) and monounsaturated (MUFA) values, as well as the lowest palmitic (C16:0), estearic (C18:0) and total saturated fatty acids (SFA) values. Although differences in intramuscular fat content were observed among the Iberian pigs lines, the texture was not affected, and the shear force (kg/cm) of all the lines were similar. Therefore, this genetic line Valdesequera would be more suitable for the production of fresh meat and of dry-cured meat products.

Keywords: Montanera system; Iberian line; fresh meat; quality.

ADAPTATION OF FINISHING PIGS TO GRADED LEVELS OF VACHELLIA TORTILIS LEAF MEAL DIET (S1OC04)

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Background: In all systems of production, feed is changed for weaners to growers and for growers to finishers. When tanniferous diets are used, pigs have to adapt with proanthocyanidins.

Objective: The current study was conducted to investigate whether V. tortilis leaf meal inclusion affect the adaptation periods in finishing pigs.

Methods: A total of 48 clinically healthy male Large White × Landrace male pigs with a mean (± SD) body weight of 63.8 ± 3.28 kg aged 14 weeks were assigned to individual pens in a completely randomized design and allotted to each of six experimental diets which contained 0, 30, 60, 90, 120 and 150 g/kg DM of V. tortilis leaf meal inclusion. Daily feed intake (DFI), average daily gain (ADG) were measured to calculate, gain: feed ratio (G: F) and the adaptation period of pigs.

Results: There was a quadratic decrease in DFI ($P < 0.001$), while ADG increased linearly ($P < 0.001$) with increasing inclusion level of V. tortilis leaf meal. Increasing inclusion level of V. tortilis leaf meal increased G: f ratio quadratically ($P < 0.001$). A linear increase in adaptation period of pigs was observed ($P < 0.05$) with increasing inclusion level of V. tortilis leaf meal. Variation of feed intake, expressed as a coefficient of feed intake, increased linearly ($P < 0.05$) with increasing inclusion level of V. tortilis leaf meal.

Conclusion: Adaptation period of finishing pigs is influenced by the inclusion level of V. tortilis leaf meal diets, by causing a positive relationship. It took pigs a short time to adapt to low levels of V. tortilis leaf meal and a longer time to adapt to V. tortilis leaf meal diets.

Key words: finishing pigs, feed intake, variation, polyphenolic compounds

USE OF RICE HUSK AS WELFARE FIBER DURING THE PREMONTANERA FEED-RESTRICTED PERIOD IN IBERIAN PIGS: EFFECTS ON GROWTH, BEHAVIOR AND BODY COMPOSITION (S1OC05)

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Due to their obesity-prone genotype, Iberian pigs must be feed-restricted during the pre-finishing period, which is named *premontanera* when preceding the acorn-feeding *montanera*. Supplementation with rice husk (an abundant and inexpensive byproduct) as welfare fiber before finishing may increase satiety sensation and decrease the hunger-derived stress and competition. These effects could reduce weight gain variability and might improve carcass uniformity and marketing conditions. The aim of this study was to evaluate rice husk supplementation during premontanera to increase animal welfare and reduce weight variability.

Castrate male Iberian pigs (n=45) were assigned to 3 treatment groups (n=15/group), which, during premontanera, from 10 to 14 months of age, were fed concentrate-based diets differing in fiber content, namely Control (C; 5.0 %), Medium Fiber (MF; 8.5 %) and High Fiber (HF; 12.0 %) groups. The MF and HF diets included rice husk (integrated into the concentrate) as a supplemental source of fiber. Daily rations were isocaloric and approximately isoproteic. During this period, pigs were housed in large outdoor corrals. Five pigs from each treatment were slaughtered at the end of premontanera, whereas the remaining animals were submitted to free-range acorn-feeding montanera and slaughtered at 16 months of age. Body weight (BW) and in vivo ultrasonographic body composition were monitored. During premontanera, behavior and welfare status (by using the Welfare Quality® protocol) were assessed, and a blood sample was collected at the end of this period to determine the neutrophil/lymphocyte ratio as a chronic stress index.

None of the groups had diarrheic problems, regardless the fiber level. In relation to behavior, the HF group showed the lowest activity, mainly after daily ration ingestion. Mean daily BW gain from the 12th to the 14th month of age was greater for the HF group, which also exhibited an apparently steadier (in time) and more homogeneous (among animals) growth rate. Moreover, the HF group had the thickest carcass backfat among the animals slaughtered before montanera and among all animals. In conclusion, supplementation with high levels of fiber (12%) from rice husk may be useful for increasing the welfare level of Iberian pigs during premontanera.

Keywords: Fatty pigs; welfare fiber; byproducts; free-range system

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BEHAVIOUR OF THE IBERIAN PIG DURING MONTANERA (S1P01)

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Iberian pig is an autochthonous breed raised in the Southwest of the Iberian Peninsula (Spain and Portugal). In the agrosystem of the dehesa, the pigs are fed by natural resources (acorn, grass, etc) during the late fattening period, called montanera. According to the regulation (RD 4/2014), Iberian pigs have to stay at least 60 days in the montanera and gain a minimum of 46 kg. The aim of this work was to study Iberian pig´s behaviour during montanera. Iberian pigs (n=72) were studied during the montanera lasting from 1st December 2016 to 16th February 2017. Pigs were weighed at the start, middle and end of this period. The observed behaviours were grouped according to inactivity or activity. Furthermore, active behaviours were secondly divided in exploration, social interactions and others (walk, run, drink, swim and comfort). Individual and social behaviours were collected during 20 observation days (90 hours in total) along the 78-day montanera, which was subdivided into two periods of 39 days each (M1 and M2) for data analysis. Pigs were slaughtered at 158.3 ± 7.16 kg of average live weight, being weight gain during montanera of 54.4 kg. The overall results showed a 77.64% of activity and a 22.36% of inactivity in the observations along the whole montanera. However, there was a decrease of activity between M1 (91.87%) and M2 (48.49%). The average weight increase (52.36% of live weight) in this period, mostly occurring during M1 (from 103.9 kg to 137.1 kg) and the expected decrease of acorn availability at the end of M2 could be the main factors affecting animal behaviour. Namely, weight gain seemed to decrease the activity of Iberian pigs, being animals more idle. In addition, acorn scarcity increased locomotion behaviour time at M2, because pigs had to move more frequently between oaks and staying less time exploring under each oak. Besides, fights were less frequent during M2, plausibly due to the stability of the hierarchy from M1 to M2. In conclusion, the length of montanera may change Iberian pig behaviour over time due to several factors, whose influence should be studied in depth.

Key-words: Iberian pig, weight gain, free-ranging, conduct

EVALUATING THE EFFECTS OF DIFFERENT INCLUSION LEVELS OF SPINELESS CACTUS ON GROWTH PERFORMANCE OF GROWING WINDSNYER PIGS (S1P02)

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Spineless cactus (SC) is an excellent source of water and nutrients for cattle, sheep and goats, especially during the dry seasons in arid and semi-arid regions in the world. Its productivity under harsh conditions is high. Pig farmers in the arid and semi-arid areas face challenges to provide nutrition for their animals and SC could mitigate these challenges. A study was carried out to evaluate the growth performance of South African Windsnyer (SAW) grower pigs fed diets containing different inclusion levels of spineless cactus. Diets containing either 0 (Control; CON), 50 (Low SC; LSC) or 100 (High SC; HSC) g/kg were formulated to provide similar energy (13.5 MJ/kg DE), protein (16 %) and lysine (1.16 %). The diets were fed ad-lib for 21 days to twenty-one SAW grower pigs (30±2 kg body mass) that were individually housed. The pigs on the CON diet had higher final weight and average daily gain (ADG) and lower average daily feed intake (ADFI) and feed conversion ratio (FCR) compared to pigs on the LSC and HSC diets. Pigs on the LSP diet had higher final weight, ADG and lower ADFI and FCR compared to pigs on the HSC diet. It was concluded that inclusion of SC depressed growth performance of SAW pigs. There is need to investigate the impact of SC on intestinal health in pigs.

Key words: Cactus, pig growth performance

PRODUCTIVE TRAITS OF CRNA SLAVONSKA FINISHING PIGS FED WITH ACORN (S1P03)

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The aim of the study was to compare two traditional ways of Crna slavonska pigs fattening and to establish differences in production traits between Crna slavonska fattening pigs fed with acorn in the final stage of the 90 days fattening period in relation to fattening pigs fed with standard meals. The study was conducted on 60 fattening pigs of both sexes divided into two groups. The control group received a standard meal of cereals in an amount of 2 kg of mixture per day, and the experimental group received only an oak acorn in the amount of 5 kg per day. Pigs in the experimental group had statistically significant ($P < 0.01$) average daily gain and final body weight compared to the control group of pigs. There were no statistically significant differences in the above-mentioned properties between male and female animals in the experimental group, while in the control group significant ($P < 0.05$) higher mean daily intake and final body weight were recorded in male animals compared to females. Economic analysis of production costs shows statistically very significant ($P < 0.01$) lower costs for Black Slavonian pigs fed with acorn compared to pigs fed by a standard cereal meal. It can be concluded that feeding of black Slavonian pigs with acorn in the finishing period has a very positive effect on the average daily gain and final weight of fattening pigs and is economically more cost-effective compared to the standard cereal-meal fattening.

Key words: Crna slavonska pig, fattening, acorn, productive traits

THE RIBATEJANO PIG: A CROSS BASED ON A FATTY PIG (S1P04)

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The Ribatejano (RI) pig productive performance, resulting from a cross between Alentejano (AL) and Bísaro (BI) breeds, was assessed within the framework of the TREASURE* project. Nine castrated male pigs from each genotype (AL, BI, ALxBI and BIxAL) were studied. Animals were raised in traditional free-range system, individually fed with commercial diets *ad libitum*, and slaughtered at ~150 kg live weight (LW). No significant (P>0.05) differences were observed between genotypes on the average daily gain. Overall, carcass length, and head and bone cuts percentages (P<0.001) were higher in BI than AL pigs, with intermediate values for both crosses. Carcass yield (P<0.01) was lower in BI and BIxAL, while commercial yield percentage (P<0.05) was lower in AL and ALxBI genotypes. Conversely, fat cuts percentage, average backfat thickness and ZP fat depth (P<0.001) were higher in AL than in BI, ALxBI and BIxAL pigs. At ~150 kg LW, RI crosses presented generally intermediate characteristics between the fatter (AL) and leaner (BI) genotypes. These trends were already observed in a previous work where these genotypes were slaughtered at ~65 kg LW (Martins *et al.* 2017). Therefore, this cross can be an alternative to the use of other breeds for crossing, and increase the income of local pig producers in a sustainable way, mitigate the exodus of rural population, and also preserve the pure breed pig populations, contributing to animal biodiversity.

Martins J.M., Neves J., Serrano A., Abecasis I., Albuquerque A., Freitas A., Nunes J.T. & Charneca R. (2017) The Ribatejano pig: Rebirth of a local population? First results on growth, and carcass parameters. Archivos de Zootecnia in press.

Key words: Local pig breeds, Productivity, Average daily gain, Carcass composition.

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Session 2. Breeding and Genetics

DIVERSITY ACROSS MAJOR AND CANDIDATE GENES IN EUROPEAN LOCAL PIG BREEDS (S2OC01)

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In the frame of the European TREASURE* project, the genetic characterization of 20 local pig breeds is being performed with genetic and genomic tools. The objectives are the study of genetic diversity in these populations and the identification of useful markers for authentication, traceability, conservation and breeding programs. In first place, a candidate gene approach has been applied and the most relevant genes and mutations associated with pig productive, meat quality, reproductive and disease resistance traits have been prioritized and analyzed. Two OpenArray® chips of 32 and 16 SNPs were designed and genotyped in 48 animals from each one of 20 breeds included in the project (Alentejana, Apulo Calabrese, Basque, Bísaro, Black Majorcan, Black Sicilian, Black Slavonian, Casertana, Cinta Senese, Gascon, Iberian, Krskopolje, Lithuanian indigenous wattle, Mangalitsa, Mora Romagnola, Moravka, Old Lithuanian White, Sarda, Schwäbisch Hällisches, Turopolje). Forty SNPs located in 34 genes were successfully genotyped (MC1R, TYRP1, NR6A, PCK1, RYR1, IGF2, MC4R, PHKG1, SCD, GBP5, TAS2R39, TAS2R4, MUC4, ESR1, CYP2E1, LEP, CAST, MTTP, CYB5A, FTO, PPARGC1A, CAPN1, PPARD, CTSL, LEPR, PRKAG3, ACACA, KIT, ACSL4, ADIPOQ, FASN, AHR, FUT1, MSTN). Results provide relevant information

regarding genetic diversity and segregation of SNPs responsible for specific production and quality traits. Coat color and morphological trait-genes, showing low level of segregation, and fixed SNPs may be useful for traceability. On the other hand, we detected SNPs which may be useful for breeding programs. For instance, we observed predominance of unfavorable alleles for disease resistance and boar taint genes in most breeds, and segregation of many genes involved in meat quality, fatness and growth. These results joint with ongoing genomic assays, will provide essential information regarding genetic diversity, structure, selective signatures and biological processes responsible for specific production and quality traits.

Keywords: fatty pig, candidate gene, diversity, allele frequency

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GENOME-WIDE SCREEN OF INTRAMUSCULAR FAT IN ALENTEJANO PIGS: UNCOVERING THE GENETIC BASIS OF LIPOGENESIS (S2OC02)

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In contrast to commercial pig breeds, Iberian pigs (of which Alentejano is a branch raised in southern Portugal) are characterized by producing highquality meat, and consequently pork products, which are highly valued by consumers. This is largely due to the inherent ability of Iberian pigs to deposit intra-muscular and subcutaneous fat, especially when they are finished on pasture and acorn, producing carcasses with higher proportion of oleic fatty acid (>53%), which is of higher nutritional value for the human diet. This inherent ability must have a genetic background, which is not well understood, and is highly dependent on an environmental factor, the availability of acorns in the finishing diet. We have conducted a GWAS study in Alentejano pigs (N = 60), all animals were genotyped using the 60K SNP chip and 153 different traits of performance and meat quality including intramuscular and subcutaneous fatty acids were measured. Quality control procedures resulted in a total of 31,384 SNPs for association analysis, which was performed by using the linear mixed model. We detected eight SNPs located within genes that have not yet been associated with meat quality and intramuscular fat. These genes are significantly associated with cell development and growth and with metabolism of proteins. These results will contribute to broaden the landscape of the involved gene network that is in the genetic basis of lipogenesis and meat quality.

BRITISH EXPERIENCE OF GENETIC MANAGEMENT OF TRADITIONAL PIG BREEDS (S2OC03)

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The British Pig Association (BPA) administers the UK National Herdbook for several traditional breeds that include some fatty breeds and others that have doc or specialist status. BPA manages 10 native breeds that are classified as rare and at risk including Large Black, Middle White and others. Unfortunately, many of these breeds have low effective population size and relatively high levels of inbreeding. In recent years the BPA has been involved in the collection of annual census data and have introduced comprehensive genetic analyses to ensure that the breeds have a long-term and sustainable future. As well as the calculation of inbreeding levels the analyses include co-ancestory evaluation, kinship relationships and 'what-if' mating forecasts. In addition, simple breeding objectives and within-herd advice on breeding plans are provided. The paper will outline details of the analyses and report on current individual breed data.

Keywords: Genetics, inbreeding, rarebreeds, native

GENETIC MECHANISM OF MIN PIG ELITE GERMPLASM CHARACTERISTIC (S2OC04)

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Determination of Min pig whole genome sequence. Through the library build sequence, DE novo sequencing, constructs the first Min pig genome sequence. Reveals the origin and evolution of Min pig. We have 48 mitochondrial genome sequences of the Chinese and foreign pig breeds, Min pig whole genome information is analyzed, the results show that Min pig and laiwu pig's closest relative, containing the Europe pig blood at the same time. Starting from features of Min pig high disease resistance, explore the molecular mechanism of immune diseases. And their molecular genetic mechanisms for further master Min pig disease resistance laid the foundation. System for Min pig cold resistance mechanism was analyzed. According to the characteristics of the Min pig to survive in the northeast cold climate, situated in, from phenomenon to essence of Min pig cold resistance mechanism for the study of different level system. In many aspects of behavior and phenotype observation, measurement, statistics and analysis, to determine Min pig fight cold ability is significantly higher than the introduction of varieties, in terms of molecular mechanism, of seasonal temperature variation and studies of severe cold stress condition. We found that the Min pig gene expression of peripheral blood cells with the seasons presents periodic variation; Muscle, fat, liver tissue under rapid temperature changes have a lot of changes in gene expression, identified four candidate genes, discovered the ribosome. Results show that Min pig has more genes than large white and fewer pathways involved in the cold stress response, but gene expression difference ratio is far lower than the large white, we concise summary of the Min pig the micro genetic frequency dynamic mechanism of cold hardiness. Through all kinds of meat quality index detection comprehensive evaluation: Min pig meat is better than that of large white. By comparing the longest back muscle transcriptome sequencing, found RYR1 differentially expressed genes were 19 genes related with the meat, such as main enrichment of differentially expressed genes in fat

metabolism related PPAR gamma and lysosome and signal transduction pathways, for Min pig fleshy excellent features in cross breeding utilization to provide theoretical basis.

BREEDING OF SONGLIAO BLACK PIG AND ITS INDUSTRIAL DEVELOPMENT (S2OC05)

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This lecture strives to briefly describe Songliao Pig´s breeding background, stages of breeding and the methods of selection used. The following experiences and thoughts on Songliao Pig could be summarized as: The breeding should target the needs of the market and provide resources in order to develop the industry; The raising of Songliao Pig is currently serving as a motor for Jilin Province on developing the industry for premium quality meat. Using Songliao Pig as the maternal line mixed with local races such as Yesong and Dasong has fixed the racial source creating a special pig label based on the Songliao Pig that is strongly growing year by year.

Keywords: China, Genetic, Songliao pig

EXPLORING THE GENETIC BACKGROUND OF FATTY MANGALITZA PIGS FROM HUNGARY AND ROMANIA AND RELATIONSHIPS WITH WILD BOARS POPULATIONS USING A SNP-BASED APPROACH (S2OC06)

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Mangalitza is one of the oldest pig breeds in Europe, being raised since the 19th century across the Carpathian basin, mainly in Hungary and Romania. Although Mangalitza pigs decreased drastically in number after the Second World War, in the last ~15 years, due to a high demand of premium ham products, their number grew significantly. Currently in Hungary there are three varieties *i.e.* blonde (BlondH), red (RedH) and swallow belly (SBH). Microsatellites and SNP analyses have demonstrated that the three Mangalitza varieties from Hungary can be considered as distinct breeds. In Romania, a small population of red variety (RedR), originating back in 1976, still survives. A comparison of genetic resources of Mangalitza pigs from Hungary and Romania and relationships with wild boars (wbHU and wbRO) from these geographical areas was not performed. Therefore the objective of our current work was to shed light into these unstudied aspects. We have genotyped 191 domestic pigs (25 RedR, 20 RedH, 37 BlondH, 56 DurocH, 48 BlondH x DurocH crosses and 5 BaznaR) and 46 wild boars (28 wbH and 18 wbR) with the Illumina Porcine SNP60 BeadChip. After quality control a total number of 38,611 SNPs were selected to carry out genetic analyses. Structure analysis revealed that wHU and wRO belong to two distinct groups. A certain level of genetic differentiation was observed between RedH and RedR populations and DNA markers distinguishing both populations are currently under investigations. A genetic signature compatible with wbH introgression was detected in both RedH and BlondH populations. This is not unexpected since receptive Mangalitza sows might have been accidentally or intentionally

crossed in the past with wild boars. No wR genetic signature was detected in RedR population. However, we detected wbH traces that can be explained by recent importation of RedH males to refresh the blood of RedR.

Keywords: Mangalitza pigs, SNP

THE EFFECT OF GENOTYPE (TORBISCAL, LAMPIÑO, RETINTO) AND FEEDING SYSTEM ON THE EXPRESSION OF LIPOGENIC GENES IN THE IBERIAN PIG (S2OC07)

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Iberian pig diet drastically changes during the montanera fattening period, from a regular protein and carbohydrate diet to a low protein, high oleic acid diet based on acorns. This variation in the diet heavily affects the fatty acid composition of the meat and possibly the expression of lipogenic genes. In this study, gene expression of three main lipogenic genes (SCD, ME1 and ACACA) is analyzed for three different genotypes of Iberian pig, namely Torbiscal (T), Lampiño (L) and Retinto (R), in two finishing systems. Sixty-five Iberian male pigs (20 L, 23 T and 22 R) were divided in 2 groups. One of them (n=31) had a regular finishing system with a concentrate-based diet, and the other group (n=34) was finished in montanera.
Genotype and diet composition significantly affected the expression of the studied genes. In relation to genotype effect on SCD gene expression, R genotype had significantly higher values than T and L genotypes, with no significant differences between these two latter. As for the ME1 gene, the L genotype had greater expression values than the T genotype, being the R line intermediate, with no significant differences with respect to the other 2 genotypes. Regarding feeding system effect, SCD gene expression had no significant differences between systems. In contrast, ME1 and ACACA gene expression values were significantly higher in regular finishing than in montanera, although the difference in ACACA expression corresponded only to the R genotype. In relation to fatty acid (FA) metabolism, montanera-finished pigs showed greater percentages of PUFA (poliunsaturated) and MUFA (monounsaturated) and lower percentages of SFA (saturated) than pigs undergoing conventional finishing. In summary, it can be concluded that the genotype significantly affected the expression of SCD and ME1

genes and that ACACA and ME1 genes had larger expression values in the conventional finishing system than in montanera.

Keywords: Genomics, Iberian genotype, extensive systems, fat metabolism

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GENETIC RELATIONSHIPS AMONG DOMESTIC PIGS IN EAST ASIA AND EUROPE (S2P01)

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We are coping with a conservation program for a genetic diversity in Vietnamese native pigs on the SATREPS project. The objective was to investigate a genetic relationship between the Vietnamese native pigs and other domestic pigs including Asian and Western breeds using the dense single nucleotide polymorphism (SNP) markers. We used DNA information from pigs of geographically separated fifteen areas in Vietnam (six in the north mountain areas, three in the suburbs of Hanoi, one in the west mountain area, and five in south areas). We also used eight western breeds (Berkshire, Hampshire, Large White, Yorkshire, Landrace, Chester White, Duroc and Pietrain), three eastern Asian breeds (Meishan and Jinhua of Chinese breeds, and Agu of Japanese native breed), and two Asian wild boars (Japan and Ryukyu). A multidimensional scaling analysis showed that the pigs were divided into mainly three groups; the western breeds, eastern breeds including the Vietnamese and Chinese breeds and the wild boars, and the Japanese breed Agu, suggesting that the Agu breed was highly divergent from the other eastern breeds and the wild boars. Results of identity-by-descent (IBD) regions sharing by fastIBD option of BEAGLE elucidated that most of the Asian breeds shared short common IBD regions with some western breeds. However, three breeds habited in the north-mountain area of Vietnam had no common IBD region with the other western and Asian breeds. Our findings indicted that some Asian breeds have been already crossed with some western breeds, and therefore we need to construct conservation programs for maintaining their genetic diversities and to investigate genetic relationships in other Asian breeds as soon as possible.

HAM SUBCUTANEOUS FAT TRANSCRIPTOME IN GROWING IBERIAN PIGS FED OLEIC ACID *VS.* CARBOHYDRATES SUPPLEMENTED DIETS (S2P02)

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Diet influences animal tissue composition by direct deposition or due to bioactive effects on metabolism, by influencing gene expression. In this study, we evaluated the effects of diets supplemented with oleic acid or carbohydrates on tissue composition and metabolism of growing Iberian pigs. A comparative study of the ham subcutaneous fat transcriptome between animals fed with both types of diet was carried out with RNAseq. A total of twenty nine weaned Iberian males were kept under identical management conditions and fed with two different isocaloric and isoproteic diets (3.3 Kcal of digestible energy and 15.6% of crude protein) provided *ad libitum*: HO diet enriched with 6% high-oleic sunflower oil and CH diet with carbohydrates as energy source. Treatment lasted seven days, from 19.9 to 24.1 kg of average LW. Fatty acid composition of animal tissues reflected the diet and indicated higher lipogenesis in CH group, as expected. We detected 198 differentially expressed (DE) genes, 48 were overexpressed in HO (FC =1.4 to 36.3; q<0.1) (i.e. *BMPR1B, PCK1* and *ALB*) and 150 in CH diet (FC =1.4 to 30; q<0.1) (i.e. *MYL1, RYR1* and *EMILIN2*). We performed a functional analysis (GO enrichment and metabolic pathways) of the DE genes, which showed enrichment of functions related to single organism process, response to stress, inflammatory and defense response, cellular lipid metabolic process, and protein serine/threonine kinase activity. In addition, we detected enrichment of metabolic pathways as focal adhesion, glucagon signaling pathways, glycolysis/gluconeogenesis, TGF-beta signaling pathway, cell adhesion molecules (CAMs) and insulin resistance. Four of these DE genes were also found as DE in a previous study of the diet effects on *Biceps femoris* transcriptome (*TBXAS1, ALB, CYP1A1* and *BMPR1B*). In this previous work, the results indicated a small effect of the diet on muscle gene expression. On the contrary, the actual results indicate a profound effect of the diet on adipose tissue gene expression, affecting relevant biological pathways.

Keywords: Iberian pig, RNA-Seq, diet, nutrigenomics

GENETIC VERIFICATION OF F1 DUROC X IBERIAN CROSSBRED BOARS (S2P03)

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Since 2014, the Spanish Standard Quality Rule (Real Decreto 4/2014) establishes that final products labelled as "Iberian" has to come from pigs with at least a 50% of genes from Iberian breed and the remaining percentage from Duroc and must also show the corresponding percentage. In addition, the rule establishes that 100% Iberian sows must be crossed with 50% Duroc x Iberian crossbred sires to obtain 75% Iberian offspring. The "Asociación Interprofesional de Cerdo Ibérico" (ASICI) carries out both morphological and genetic controls in the aforementioned sires in order to monitor the compliance of the regulation. The objective of the current study consisted in checking the percentage of Iberian and Duroc alleles of 50% Duroc x Iberian crossbred sires used to obtain 75% Iberian pigs. Blood samples of 636 sires were collected from 165 farms which are located in eight different provinces (seven in Spain and one in Portugal). From these samples, the genomic DNA was extracted and genotyped with a custom-designed OpenArray™ SNP chip developed by our group, which allows discriminating the percentage of Iberian and Duroc genes of each individual. The genotyping data of these animals and those from two reference populations with well-known genetic origin (119 Iberian and 77 Duroc) were analyzed using BAPS 5.3. The estimated mean percentage of Iberian alleles of the 636 problem samples was 50.5%. A percentage of 67.1% of the analysed samples showed percentages of Iberian alleles ranging from 45 to 55%, compatible with a F1 Duroc x Iberian genetic type, while a 14.8% of samples present percentages of Iberian alleles lower than a 45%. Taking into account the provinces, in one of them there were a 90.91% of individuals with a percentage of Iberian alleles between 45-55% and other which have a 51.15% of individuals with a percentage of Iberian alleles between 45-55%. Although these results show that a majority of sampled genomes have

an estimated alleles of Iberian origin close to 50%, these kinds of genetic controls must be carried out in order to assure the correct compliance of the rule.

Keywords: Duroc x Iberian boars, Quality Rule, SNP chip, traceability

PLACENTAL EXPRESSION OF GENES INVOLVED IN ANTIOXIDANT HOMEOSTASIS AND VASCULARIZATION IN IBERIAN PIGS (S2P04)

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During pregnancy, adequate placental efficiency and correct feeding of sows are essential for optimal development of fetus and adequate weight at birth of piglets. One approach to improve placental efficiency is the prenatal sow supplementation with different antioxidant agents improving placental antioxidant capacity and its vascularization. This strategy may protect fetal tissue against the deleterious effects of reactive oxygen species during the critical phases of embryogenesis and organogenesis. Hydroxytyrosol is a polyphenol present in olive fruits with antioxidant, metabolism-regulatory, anti-inflammatory and inmuno-modulatory properties. The aim of this study was to evaluate the effects of a sow diet supplemented with hydroxytyrosol on placental gene expression of enzymes involved in oxidative processes, vascularization and prenatal growth (*SOD1, CAT, HIF1A, VEGFA, NOS2, IGF1, UCP2*). From day 35th of pregnancy, 6 Iberian sows were treated with 1.5 mg/kg of feed day of hydroxytyrosol ("H") whilst other 4 acted as controls ("C"). At 100 days of gestation, 40 placental tissue samples corresponding to both fetal genders and treatments (10 H-males, 10 H-females, 10 C-males and 10 C-females) were collected and used for total RNA extraction and gene expression was measured by RT-qPCR. Regarding genes involved in antioxidant processes, significant interaction treatment*sex effects were found for *SOD1* and *HIF1A* (p=0.008 and 0.04 respectively). According to this interaction, males subjected to antioxidant treatment showed higher expression than females. Contrarily, in the control group, the opposite sex effect was observed, with females showing upregulation of *SOD1* and *HIF1A*. The same pattern was observed for *CAT* and *VEGFA* genes, although these genes did not show statistical significance. A trend for higher *CAT* expression was observed in males (p=0.07 for the gender effect). No significant effect was detected for genes involved in prenatal growth. The expression of *CAT, VEGFA, HIF1A, SOD1* and *NOS2* genes was highly correlated ($0.34 \leq r \leq 0.81$; $0.03 \leq p \leq 0.0001$). Moreover *CAT* gene was negatively correlated to fetal weight (r=-0.5, p=0.001) suggesting a placental response to impaired fetal growth. Results

confirm the functional relationship among the studied genes involved in antioxidant homeostasis. Also we provide evidences of the complex effects of maternal hydroxytyrosol supplementation on placental gene expression, with interesting gender differences.

Keywords: prenatal growth, gene expression, placental, hydroxytyrosol

COMPARISON OF GENE EXPRESSION REGULATION IN PORK CARCASSES DIFFERING IN INTRAMUSCULAR FAT CONTENT (S2P05)

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Previously, we identified quantitative trait loci (QTL) for intramuscular fat (IMF) content in Duroc pigs. Introgression of those QTL by marker-assisted selection enabled to establish a novel Duroc strain (DIMF) with twice as much IMF content as a basic Duroc strain at Gifu prefectural Livestock Research Institute. Today, the DIMF strain produces highly marbled pork meat: average IMF is 6%. Therefore, we aimed to identify genetic factor(s) which are associated with IMF content in pork carcasses by comparing expression differences of functional genes and microRNA (miRNA) genes, and to investigate relationships of those in *longissimus dorsi* (LD) muscle. Pork carcasses were produced by Landrace and Large White crossbred sows mated with DIMF boars (LWD). IMF content was measured using Soxhlet extraction apparatus. According to the IMF content, we took each of 16 top and bottom IMF carcasses consisting of 8 each of barrows and gilts. Simultaneous gene expression analyses were conducted using Agilent microarrays for 44K messenger-RNA (mRNA) specific to pig genome and 80K micro-RNA (miRNA) including all pig and human miRNAs available from databases. Differentially expressed genes were analyzed by *t*-test. Differential expression with $P<0.05$ and FDR<0.05 were defined as statistical significance. Mean values of IMF content in the top and bottom carcasses were 5.05 and 3.19, respectively ($P< 0.001$). However, backfat thickness and rib eye area were not significantly different between top and bottom IMF carcasses. The miRNA array detected four significant miRNAs which were upregulated in top IMF carcasses. On the other hand, seven functional genes were detected as downregulated genes by mRNA array in top IMF carcasses. Among the downregulated genes, low-density lipoprotein receptor class A containing 3 (*LDLRAD3*) is associated with cholesterol metabolism so that the result may reflect the difference in fat deposition in carcasses between high and low IMF groups. Furthermore, phosphoprotein membrane anchor with glycosphingolipid microdomains 1 (*PAG1*) gene which is considered to

be one of target of the miRNA was downregulated in top IMF carcasses. These results suggest that the miRNA could be available molecular marker estimating IMF content of pork meat.

Keywords: gene expression, intramuscular fat, meat quality, microRNA

DEVELOPMENT OF GENETIC MARKERS IN THE ALENTEJANO PIG BREED: THE SELECTPORAL PROJECT (S2P06)

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Presently, the identification of genetic markers in farm animals, species with complex genomes, is greatly enhanced by the substantial volumes of sequence data that can be generated with high-throughput sequencing. In the context of local breeds of domestic animals, technologies like genotyping-by-sequencing (GBS) offer the possibility of simultaneously identify and genotype thousands of SNPs across populations comprising hundreds of individuals. In this project, we will evaluate the effect of thousands of SNPs, identified with GBS; on phenotypic traits of interest for the Alentejano pig breed, like porcine growth, sow productivity, carcass traits and meat quality, in order to identify the genetic markers involved in the genetic regulation of those traits. We will study and characterize the genetic variation present in the genomes of 3,000 pigs. The identification and validation of molecular markers linked with the studied phenotypes will be available to be used in the genetic breeding program of the Alentejano pig breed, where the genetic marker information will be incorporated, along with the already available phenotypic and pedigree records. It will allow an early identification of pigs carrying the most desirable genotypes associated with better performances, which will ultimately benefit the producers.

Additionally, we will develop a traceability system, based on the identification of breed-specific SNPs, which will be a powerful tool for the molecular traceability of the Alentejano based products to their breed of origin, thereby creating a much needed mechanism to protect producers from frauds and ensure food safety to consumers.

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THE EFFECT OF IBERIAN GENOTYPE AND FEEDING SYSTEM IN CARCASS COMPOSITION OF IBERIAN PIGS (S2P07)

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Carcass traits of three pure Iberian pig strains (Retinto, R; Torbiscal, T; Lampiño, L) fed in a regular concentrate-based system and in montanera system were studied. Sixty-five Iberian male pigs (20 L, 23 T and 22 R) were divided in 2 groups, 31 of them had a protein and carbohydrate equilibrate diet (conventional finishing system) and 34 were designated to have a montanera-based finishing with acorns. Two days before slaughtering, animals were weighed and ultrasound scans were performed at the loin level (between the 10th and 11th rib), at the gluteus and at the semitendinosus levels with an Aloka machine with a 12-cm probe, and the images were digitalized in a computer and measured by using the NIH's Image-J software. The subcutaneous fat measurements were defined as total subcutaneous fat=TSF10, (inner= ISF10, medium=MSF10 and outer=OSF10), gluetal fat=GSF; and semitendinosus fat=SSF. At the packing plant, carcass and prime cuts (ham, foreleg and loin) were weighed and yields were recorded. Meat and fat samples were collected to evaluate the percentage of intramuscular fat and he fatty acid composition.

The Torbiscal genotype had significantly greater values for ham, foreleg and loin yields and significantly lower values for subcutaneous fat thickness (except for the OSF10 layer) than Retinto and Lampiño lines. Moreover, Lampiño and Torbiscal had significantly lower PIF than Retinto. Regarding fatty acid composition of subcutaneous fat, Retinto had the greatest percent of MUFA (monounsaturated fatty acids) and Lampiño the smallest one. Conversely, Lampiño had the greatest content of SFA (saturated fatty acids). In relation to feeding system, the conventional one produced pigs with higher meat yields, whereas the montanera feeding system was characterized by thicker subcutaneous fat in comparison with conventional feeding, with the exception of gluteal subcutaneous fat. On the other hand, montanera-finished pigs

showed higher percentages of MUFA and lower percentages of SFA than pigs finished in a conventional system.

Key words: Iberian line, diet, extensive systems, carcass traits

Acknowledgements: this research was supported by FEDER funds and the ESTRIBER project (Junta de Extremadura).

Session 3. Physiology and Reproduction

MANAGEMENT EFFECT ON REPRODUCTIVE AND PRODUCTIVE CAPACITY OF MANGALICA PIGS (S30C01)

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Much misunderstanding is circling among breeders what proper nutrition and housing technology should be used in native pig breeding for optimizing economic outcome. Using Mangalica pig as an example we figure out that even such an indigenous pig of modest feeding and housing demands can pay back the carefully planned feeding strategy and the well established housing technology. Generally native pig breeds tolerate poor conditions better than their intensive counterparts nevertheless many times farmers determine the nutrition supply and building structure not attaining the physiological demand of Mangalica necessary for profitable production and reproductive performance. In the present study we want to differentiate 'surviving' and 'prosperous function' of Mangalica farming to underline the importance of feeding and housing system set up professionally.

During history of the recent nearly two centuries Mangalica demonstrated its' ability for living under extreme climate and keeping circumstances as well as being resistant against serious epidemic diseases. Based on the mentioned features some farmers concluded that Mangalica needs almost nothing for its' normal life and try to run the business by very low initial and continuous investment. Reproductive and productive results of 19 Mangalica production farms were collected with special regard on different keeping and feeding methods. Selection was done for finding farms of high level and low level results. Number of sows per farm was ranging from 5 to 800 heads. Housing method was either free range or free range + closed shed or only closed buildings. Insemination or mating rate, average number of weaned piglets and feed conversion rate were compared.

Results were the following. Farms of intensive and differentiated feeding, partly closed buildings produced the best fertilization rate, number of weaned piglets per sow and feed conversion rate i.e. over 80%, 5 piglets and 5 kg on average, respectively. Intensive feeding means nutrition fitted specifically for the physiological demand of Mangalica, not the usual feed of commercial breeds.

We can conclude that profitable Mangalica production needs professional knowledge, sophisticated farm management, suitable buildings and pens. Indigenous pig breeds can produce on high level if proper conditions are ensured for them. Neither conditions of commercial pigs nor overridden 'low input breeding' are creating optimal frame for Mangalica production.

Acknowledgements: We thank the Hungarian National Association of Mangalica Breeders for providing data.

ANALYIS OF SPECIAL INFLUENCING FACTORS ON THE ESTROUS BEHAVIOUR AND FERTILZATION IN SOWS (S3OC2)

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Reproduction performance in sows is a very sensitive feature complex, both in high-performance, white breeds and fatty pigs. Complex “fertility and reproduction performance” include estrous behaviour, number of ovulated egg cells and proportion of fertilized egg cells (potential fertility). Additionally early embryonic mortality and prenatal mortality are important for reproduction performance (real fertility). Numerous different influencing factors stimulate, other factors inhibit. Present investigation includes only estrous behaviour, pregnancy rate and litter size after fixed time AI. Following influencing factors were analyzed: - Estrous behavior in female pigs beginning in their first parity and in their following parities. - Phenotypic correlations between first check of standing behavior in estrous before first, second, third pregnancy and duration of standing reflex in these periods. - Onset of heat in sows in different generations (heat before 2nd and 3rd pregnancy, sows in generations 1 to 6). - In groups if sows in heat the special time for AI is important for fertilization rate and litter size. Last inseminated sows in one group realized lower reproduction performance than first inseminated sows in group. A high fertilization result in sows requires a process chain, which allows a coordinated interaction between many physiological part factors of the animal and factors caused by human beings. Following factors are important: - a short and intense stimulation of the estrous behaviour with the boar, - operational modifications of the insemination with regard to a maximum possible proportion of sows with standing reflex at the insemination time, - estrous behavior of sows is highly influenced by the environment. These include season, time of insemination, individual ability of the person, position in stable, light etc., - If biotechnical methods for fixed time AI are used, insemination time is largely defined by them. A short period of time for AI is necessary. High variations in periods of time for AI adversely affects the pregnancy rate and litter size.

Keywords: sows, influencing factors, estrus, fertility

PLACENTAL CHARACTERISTICS OF HUNGARIAN MANGALICA AND GERMAN LANDRACE SOWS AND THEIR RELATIONSHIPS TO FERTILITY PARAMETERS (S3OC03)

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The placenta is the central fetal organ, which has to ensure a sufficient exchange of nutrients and metabolites for an adequate fetal growth. Specific data of placental characteristics of modern pig lines with high fertility and current data for fatty pig breeds like the Hungarian Mangalica are not available. Therefore, this study focusses on a comparative description of placental size of Landrace and Mangalica pigs and their relations to important fertility parameters. As basis for the data collection 55 litters from primi- and multiparous German Landrace sows with in total 832 born piglets (15.1 ± 3.5/litter) were used and their placentas were weighted, the length measured and the placental efficiency per litter calculated. Parallel to this, 18 Hungarian Mangalica sows with in total 143 born piglets (7.9 ± 1.8/litter) were investigated and their placentas measured.

Overall we found, that mean placental weights ranged from 130g to 422g between litters and the mean length varied from 61cm to 145cm. The investigated parameters were only slightly affected by the litter number ($r = 0.3$). Mangalica piglets were a bit heavier in average than Landrace piglets (1.5 ± 0.23Kg vs. 1.4 ± 0.23Kg) however their placentas were lighter (234± 37g vs. 277±54g), which led to a significantly higher placental efficiency in Mangalica compared to Landrace (6.8 ± 1.5 vs. 5.1 ± 0.7; $p<0.001$). In Landrace sows we found, that with increasing piglet numbers the piglet weight and placental length is significantly decreased ($r = -0.3$ and $r = -0.4$), this might be due to limited uterine space. However, in both breeds piglet number was positively correlated with the total placental weight of the litter (Landrace: $r = 0.7$; Mangalica: $r = 0.5$) and therefore placental efficiency

was not affected by higher fertility of the sows in this study. Higher average placental weights (Landrace: r = 0.7; Mangalica: r = 0.6) and lengths (Landrace: r = 0.7) of a litter improved piglet birth weight significantly. Our findings showed variability of placental characteristics between sows which suggests the opportunity for a placental based breeding selection to improve piglet weight as well as their health.

Keywords: pig; placenta; fertility; placental efficiency

EFFECTS OF LOW BIRTH WEIGHT ON THE IMMUNE FUNCTION OF IBERIAN PIGLETS (S3OC04)

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A major drawback to the outstanding improvement in litter size accomplished by the pig industry is the loss of litter homogeneity and the increased incidence of low birth weight (LBW) piglets. These negative effects are even more pronounced in rustic breeds like the Iberian pig, characterized by lower prolificacy and higher heterogeneity compared to commercial lines. Apart from compromising production traits like growth and carcass quality, a LBW is associated with increased disease and mortality rates, which might be indicative of immunodeficiency. Thus, our study objective was to investigate the consequences of a LBW on immune parameters and function in Iberian piglets. Within each litter, same-sex pairs (n = 15; 7 female and 8 male pairs) composed of a normal birth weight piglet (average litter weight; NBW) and a LBW one (1 standard deviation below average litter weight) were selected at birth. As expected, all morphometric parameters were decreased in LBW piglets compared to NBW controls at birth ($P < 0.02$). Further, LBW piglets showed signs of asymmetric intrauterine growth, as morphometric measurements became larger in this group when normalized to body weight ($P < 0.001$). In order to evaluate antibody production capacity, all piglets were immunized with ovalbumin (OVA) at 57 and 65 days of age. Plasma samples were collected on d0, 8, and 16 relative to the first injection for anti-OVA IgG determination. In response to immunization, LBW piglets produced more circulating OVA-specific IgG than NBW counterparts (133 vs. 83 x 104 ng/ml; $P = 0.01$). At 72 days-old, circulating band neutrophils were increased in LBW piglets compared to NBW controls (639 vs. 197/µl; $P = 0.03$). These preliminary data suggest that LBW Iberian piglet show evidences of an altered immune function, which might be ultimately responsible for its increased morbidity and mortality.

Keywords: Iberian pig Homogeneity Low birth weight Immune function

INCLUSION LEVELS OF A-TOCOPHEROL SUPPLEMENTATION ON GROWTH PERFORMANCE AND TESTICULAR DEVELOPMENT OF WINDSNYER BOARS (S3OC05)

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Growth and testicular development of pigs is largely accounted by energy and protein consumption, it is possible that α-tocopherol inclusion may further enhance average daily gain and feed efficiency in pigs. Slow growth rate of Windsnyer pigs is their major weakness. The study was conducted to determine the response in growth performance and testicular development of Windsnyer boars to α-tocopherol supplementation. Twenty Windsnyer boars aged 3 months old with an average body weight ± (standard deviation) of 19.5 ± 2.67 kg were selected. Each pig was housed individually in a 1.54 x 0.8 m pen in environmentally controlled house with the temperature ranging from 22 to 250C. Pigs were kept until they reached an average body weight of 57 kg. Five boars were randomly assigned to each diet containing inclusion levels of α-tocopherol 0, 40, 70 and 90IU. Polynomial regression analysis was used to determine the relationships between α-tocopherol inclusion level and growth performance and testicular development. Supplementation of α-tocopherol inclusion levels had a quadratic relationship with body weight of Windsnyer boars. There was a quadratic decrease ($P<0.05$) in average daily gain (ADG) as α-tocopherol levels increased. The equation was $y= -0.0083x2 + 0.7786x-0.08$. There was no relationship between α-tocopherol and testicular development and testicular tissues ($P>0.05$). There was a tendency ($P=0.09$) of quadratic increase in seminiferous tubule with increase in α-tocopherol inclusion level. The testicular tissues were at the normal range for boars. In conclusion, α-tocopherol inclusion levels has a

quadratic relationship with average daily gain and body weight of Windsnyer boars. Testis and testicular tissues remain at normal range were not influence by α-tocopherol inclusion.

Keywords: feed intake, feed conversion ratio, growth rate

EFFECTS OF NUTRITIONAL PREGNANCY MANAGEMENT ON CARCASS AND MEAT FEATURES OF OFFSPRING: IMPLICATIONS FOR THE PRODUCTION OF DRY-CURED PRODUCTS (S3OC06)

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The increasing demand for high-quality dry-cured products from traditional breeds has changed management practices into more intensive rearing as in modern breeds. A current objective is the increase of prolificacy. However, this increase may have adverse consequences like heterogeneity in birth-weights of the litter and appearance of intrauterine growth restriction (IUGR) in some of the offspring. One of the most concerned consequences is a high within-litter variability in carcass conformation and meat quality, which affects profitability in the production of dry-cured products. The IUGR process may be even more severe in fatty pigs because sows are characterized by lower prolificacy and uterine capacity, leading to a high incidence of low birth-weight piglets. Moreover, fetal metabolism and growth patterns may also be affected in case of maternal undernutrition. Pigs that suffer IUGR show low growth rate, feed efficiency and meat yields, high adiposity, and changes in meat composition and muscle structure. These effects are also modulated by the offspring sex. In fatty pigs, piglets from pregnancies affected by maternal malnutrition during the entire pregnancy show similar birth-weight to piglets from sows with adequate nutrition but accelerated growth during the growing phase developing higher body weights but also higher fatness. On the other hand, pigs from pregnancies affected by late undernutrition are lighter at birth than offspring from sows with adequate nutrition. However, postnatal growth is modulated by sex and therefore restricted females show a catch-up growth for reaching similar weight than control females, but males remain lighter. At slaughter, restricted males have low intramuscular fat (IMF) content and similar values of visceral fatness than control males. Meat quality is also affected since restricted males have higher values of linoleic acid (C18:2n-6) in loin than males from pregnancy with adequate nutrition. Meat color is also affected by

prenatal restriction, although modulated by sex and birth-weight of the piglet. The IMF content, the FA composition and the meat color are important traits for dry-cured products because of their influence on sensorial evaluation of the final product and, thus, on the quality of these meat products.

Keywords: IUGR, meat quality, fatty pig, fatty acids

THE EFFECT OF SELENIUM AND ZINC SUPPLEMENTATION ON GROWTH PERFORMANCE OF FINISHER KOLBROEK BOARS (S3OC07)

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To evaluate the effect of dietary Selenium and Zinc supplementation on growth performance of finisher Kolbroek boars. A total of 24 Kolbroek (KB) finisher boars aged 3 to 4 months with average live weight of ± 28 kg were used for the study. The KB boars were assigned to five experimental diets with 5 KB boars per treatment. The diets were; control, low–selenium, low-zinc (0,26; 0,34g/kg) (LSeLZn); high-selenium, high-zinc (0,65; 0,74g/kg) (HSeHZn); low–selenium, high-zinc (0,26; 0,74g/kg) (LSeHZn) and high-selenium, low-zinc (0,65 0,35g/kg) (HSeLZn). The KB boars were fed 1.5 kg of feed per day until the end of the experimental period which lasted two months. Average daily feed intake (ADFI) was measured daily by subtracting refusals from feed offered. The pigs were weighed weekly. Feed conversion ratio (FCR) was calculated by dividing the feed intake of each pig by the average daily gain. Supplementation of Se and Zn had no effect on ADG, ADFI, weight gain (WG) and FCR of the KB ($P>0.05$). The back fat thickness of Kolbroek boars was not affected by interaction of Se and Zn supplementation ($P>0.05$). There were no difference ($P>0.05$) in initial weight and final weight between treatments. Feed intake was not affected by diets in the finisher KB boars ($P>0.05$). The results agree with other studies that showed that different dietary Se products and levels did not influence growth performance in growing-finishing pigs. In conclusion, interaction of selenium and zinc supplements did not produce any significant effects on growth performance of finisher KB boars.

Keyword: Kolbroek, growth, selenium and zinc

NEW SYSTEMS OF SEMINAL QUALITY ANALYSIS (S3OC08)

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The aim of the Centers for Artificial Insemination (CIA) is to provide semen doses to farmers, with a total guarantee of their quality and therefore their ability to fertilize. Until now, the systems of analysis of the seminal quality, have been based in motility. The following parameters are calculated by analyzing different images, obtained with the aid of a phase contrast microscope, through the manual focus performed by an operator. This gives the sperm concentration and the morphoanomalies of the ejaculate.

There is a new equipment, Seminal Quality System (SQS) for the evaluation of the different parameters, in a single machine, of a small size, with an internal fluorescence microscopy system and an automatic multi-focusing, are unified, guaranteeing the analysis of hundreds of cells in very little time. The great advance is that in a minimum time and in an objective way, a reliable information is obtained on the potential fertilization capacity of the ejaculate, as well as the sperm concentration and the percentage of each of the most habitual abnormal forms that are usually present.

The purpose of the present work is to validate the "Automated Semen Quality System" in University of Murcia (Spain) as a tool to determine seminal dose production from boar sperm. Since SQS assess the number of seminal doses to produce based on the number of useful spermatozoa (viable) and its morphology, the technique that we will apply in this validation will be the quantification of number of spermatozoa in terms of spermatic concentration, quantified by the NucleoCounter SP100 (ChemoMetec A/S, Allerod, Denmark), spermatic viability determination through flow cytometry and quantification of morphologically normal spermatozoa through phase contrast microscopy.

The SQS allows to know the quality of the seminal doses quickly and objectively, eliminating the subjectivity of the current procedures, not to depend on the effectiveness of the human being, nor to be

affected by the different environmental variables, such as temperature, that can influence in a decisive way in the evaluation of a parameter so used so far as is the motility of the sample.

Key words: pig, semen, analysis, SQS

EFFECTS OF FEEDING BROWN RICE ON THE PERFORMANCE OF FATTENING PIGS AND LACTATING SOWS (S3P01)

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To improve the food self-sufficiency and take measure against decreasing domestic rice consumption, the Japanese government has subsidized cultivating rice as feed since 2010 and promoted feeding rice to livestock. We investigated feeding brown rice, as an alternate ingredient to corn, to fattening pigs at an experimental scale and general pig farm. We also examined its effects on lactating sows as well as its piglets.

Ibaraki Prefecture where the NARO is located is one of the major sweet potato production area. Therefore, there are waste sweet potato from sweet potato processing. In the experiment 1, we substituted brown rice and sweet potato for all of corn in the diet and fed fattening pigs it at an experimental scale. There were four levels of ratios of brown rice, 0%, 30%, 52.5%, and 75%, while those of sweet potato were 0%, 22.5%, 22.5%, 0%. Live-weight gains, feed intake, and feed efficiencies were not affected by the substitution of corn with brown rice and sweet potato. Feeding brown rice increased the total ratios of saturated and monounsaturated fatty acids in the inner layer of subcutaneous fat and decreased those of poly-unsaturated fatty acids. In particular, oleic acid ratios increased while linoleic acid ratios decreased. We also report the results of the field trial where we investigated the effect of brown rice and sweet potato byproducts on growth performance and pork quality on fattening pigs managed by pig farmers.

In experiment 2, we examined the effect of brown rice on the weaning-to-estrus interval, immunoglobulins in the milk and serum of lactating sows, and the growth performance of piglets. Feed intake, growth performance, back fat loss, and weaning-to-estrus interval of sows, and growth performance of piglets did not significantly differ between treatments. There was no significant change in IgA and IgG

levels in milk; however, total protein level in plasma and IgG in serum of sows fed brown rice were higher than those of control sows.

Brown rice is not inferior to a corn-based diet in the growth performance and meat quality of fattening pigs and the performance of lactating sows.

ONSET OF PUBERTY IN KOLBROEK GILTS USING HORMONAL ASSAYS (S3P02)

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The onset of puberty is one of the basic reproductive events in the sexual life cycle of domestic animals but factors that control these events are poorly understood. The objective of the study was to determine the onset of puberty in Kolbroek gilts using hormonal assays method. A total of 13 indigenous Kolbroek gilts aged three months were used in the study. Body weight of the gilts were recorded weekly. Blood was collected from the jugular vein every 2 weeks for 5 months using a 10ml syringe and collected in to heparinized glass tubes and stored in to Styrofoam box containing crushed ice. Immediately after collection blood was transported to the laboratory. Upon arrival, blood was centrifuged at 2400rpm for 14 minutes and stored at -200C. The serum profile of Luteinizing Hormone (LH), Follicle Stimulating Hormone (FSH) and Estradiol (E2) of the gilts were determined using Elisa kits. Data was entered into the Excel datasheet and descriptive statistics were performed. Data analysis was performed with SAS version 9.3 statistical software (SAS).The results revealed that there was a significant increase ($P<0.001$) in LH concentration between (0.22-0.35ng/ml) at 3 months. Moreover, an increase in FSH concentration (0.22±0.2 ng/ml was observed in all gilts from the age of 3 months reaching a maximal level of 0.35ng/ml at 6 months. Concentration of Estradiol (E2) increased significantly ($P<0.01$) between (4.3-8.9ng/mL) at 3 months and also increased significantly ($P<0.01$) between (5.5-9.0ng/mL) at 4-7 months. There was no significant ($P>0.01$) difference between Kolbroek gilts for hormonal concentration in serum. However, there was a significant

increase (0.22-0.35ng/ml) in all the hormone concentrations from 3-7 months of age. In conclusion, the age of attainment of puberty in Kolbroek gilts was found to start at 3 months and reached a peak at 7 months. The hormonal assays method was found to be a clear indicator of the exact onset of puberty in Kolbroek gilts.

Keywords: Kolbroek gilts, Puberty, Hormone assay, Oestrus detection

Session 4. Meat quality and products

THE QUALITY OF MEAT AND CURED MEAT PRODUCTS IN EUROPEAN FATTY PIGS (S40C01)

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The quality of meat and cured meat product from native European pig breeds is affected by genetic, environmental rearing/feeding effects. Many of the main European local breeds are characterized by an higher adiposity of carcass and meat and they have an interesting quality of products with respect to improved pigs. Moreover, this breeds are not reared in intensive way but, frequently, in free range conditions. It is well known that the outdoor system increases the value of animal products due to the influence of pasture the chemical, physical and sensorial characteristics of the product. Traditional food products of high quality, such as those obtained from animals reared outdoor, or supplied by unimproved breeds, are in high demand. The studies carried out on autochthonous pig breeds on local European breeds, have focused on various topics: - genetic, aimed at averting the danger of extinction and reducing inbreeding; - feeding, to evaluate the effect of different feeding source on quality of products; technologic, to describe the effect of different curing processes on the quality of products. The purpose of this review is to analyse the literature on pig breeds of Europe, with particular reference to the effects of genetics and breeding systems on the quality of products. As regard the genetic effect, the term “improved” generally refers to the cosmopolitan pig breeds that have undergone genetic improvements aimed at enhancing their productive performance. Some scientific studies have compared native pigs with “improved” ones, so it is possible to verify the actual gap between the two genetic types and to evaluate the effects of genetic improvement in swine during the last half century. As regard the rearing/feeding system, the local breeds are almost always reared outdoors so, the environmental effects on quality are the combined result of both the farming system and the feeding regimen. The purpose of this key-note is to analyse the effect of some affecting factors on the quality of meat and meat products of European pig breeds with particular reference to the effects of genetics and rearing systems.

EFFECT OF GENOTYPE AND SALT CONCENTRATION ON THE QUALITY OF PORTUGUESE TRADITIONAL *PAIOS* (S40C02)

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Nowadays, there is an increasing demand for traditional food products, which is concomitant with higher nutritional and health concerns. The need to reduce salt concentrations or replace NaCl by salt substitutes, such as KCl, has been evidenced by the World Health Organisation, who recommends daily salt intake values of 5 g, corresponding to less than 2 g of sodium. Alentejano (Al) and Bísaro (Bi) are two autochthonous Portuguese pig breeds, traditionally reared in extensive systems. Al is a fatty pig closely related to the Iberian pig, belonging to the group of the Mediterranean pigs, while Bi fits within the Celtic pigs. One of the most appreciated Portuguese traditional dry-cured meat products is *Paio*. For this study made in the frame of the European TREASURE* project, *Paios* were manufactured at a local production unit, using two different pig genotypes: pure breed Al and the hybrid genotype BiAl. Products were made with two different NaCl concentrations in the final product, namely 2 and 6%. The main aim of this work was to evaluate the differences in quality between the two genotypes, while attempting to reduce salt without compromising safety standards or consumer acceptability. The effect of genotype and salt content on physicochemical and microbiological parameters, along with sensory attributes, was studied on Portuguese *Paios*. Regarding total lipid content, there were significant differences between genotypes, with hybrid BiAl products showing higher values. Concerning pH and water activity (a_w), significant differences were observed between salt contents, with low-salt products showing lower pH, but higher a_w values. The total content in biogenic amines was higher in Al

products, mainly due to the amounts of putrescine and cadaverine, resultant from the presence of decarboxylating bacteria. Generally, low-salt *Paios* showed a higher content in biogenic amines. Furthermore, salt reduction did not depreciate the quality and acceptability of sausages.

Keywords: Low-salt; Alentejano pig; Bísaro pig; dry-cured meat products

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EFFECT OF THE IMMUNOCASTRATION PROTOCOLS ON HAM COMPOSITION EVALUATED WITH COMPUTED TOMOGRAPHY (S40C03)

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Immunocastration is an alternative to surgical castration for pigs. Because of the long life cycle of Iberian pigs, the standard immunocastration protocol was modified to 3-dose of vaccine. Ham is one of the most valuable piece of Iberian carcass. The aim of the present work was to evaluate the influence of two immunocastration protocols: pre-pubertal (P) and pre-finishing (F) on the composition of hams from Iberian pigs by means of computed tomography (CT). For this purpose, 20 male pigs were immunocastrated (10 per immunocastration protocol) and slaughtered in commercial conditions with a final carcass weight of 135.0 + 5.4 kg (pre-pubertal) and 121.0 + 5.8 kg (pre-finishing). The ham was frozen until the scanning and thawed at 4ºC one week before the scanning. Hams were CT scanned with the GE HiSpeed Zx/I equipment. Scanning protocols were 140 kV, 145 mA, 10 mm-thick, matrix 512x512 and displayed field of view 350 mm. Image analysis was performed with the software VisualPork and the distribution of volume by Hounsfield value (HU) was determined. Fat was considered the volume between HU -149 and HU -1, lean the volume between HU 0 and HU +140 and bone the volume between HU +141 and HU +1400. Furthermore, the proportion of each tissue was also calculated. Statistical model included treatment as fixed effect and animal as random effect. Because of the differences in weight between treatments, the carcass weight was used as covariate. Results showed significant differences between immunocastration protocols in the lean tissue volumes, being this higher for F pigs. Regarding the proportion of each tissue, hams from P immunocastration pigs have significantly higher fat and bone and lower lean proportion than those of F immunocastration protocol.

Keywords: pig castration, computed tomography, ham tissues, Iberian pigs

LOW-PROTEIN DIET FOR DUROC X IBERIAN CROSSBRED PIGS: INFLUENCE ON FATTY ACID COMPOSITION OF SUBCUTANEOUS ADIPOSE TISSUE (S40C04)

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The use of low-protein diets can involve two advantages, one economic and the other environmental. In addition to this, it is also important to know the influence on the meat composition. In this sense, the energy ingested can be used in a different way for tissue synthesis and therefore, the adipose tissue fatty acid composition could be modified. The aim of this work is to find out the consequences of supplying a low protein diet during the growing period on fatty acid composition of subcutaneous adipose tissue on fatty pigs. A total of 61 castrated crosbred, Duroc x Iberian male pigs were available. The experiment was carried out in two experimental series (exp1 n=28 and exp2 n=33). Two diets were provided: one control-C with 16.5% crude protein (CP) and a low protein-LP diet with CP=11.5% in exp1 and CP=10% in exp2. Pigs started the experiment with a live weight of 28 kg (exp1) and 38 kg (exp2). They were fed with the experimental diet until reached a live weight of 98 kg. At this time, 5 to 7 pigs from each batch were slaughtered. The remaining pigs (8 to 10 pigs per batch) were fed with a fattening feed containing 13.5% CP until they reach 155 kg of live weight and they were slaughtered. After the slaughter, a portion of subcutaneous adipose tissue was taken at the tailbone level and the fatty acid composition was analysed. After the growing phase, there was an effect of the experimental series on fatty acid composition. Exp2 showed higher levels of monounsaturated and lower levels of polyunsaturated and saturated. In addition, LP diets increased oleic acid and lowered

polyunsaturated, while saturated fatty acids remained identical compared with the C diet. However these differences disappeared when the same diet is supplied during the fattening period.

Keywords: Fatty acids, low protein diet, subcutaneous adipose tissue, Iberian pigs

OLIVE CAKE-BASED GROWING DIET FOR MONTANERA IBERIAN PIGS: EFFECTS ON MEAT QUALITY TRAITS (S40C05)

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The traditional production system of Iberian pig includes a particular finish-fattening period called *montanera*. This semi-extensive system is based on *ad libitum* intake of grass and acorn, which has a positive effect on meat quality and favors animal wellbeing. However, the restricted diet supplied during the growing period to prevent a non-desirable fatness percentage in final pig products could cause feeding stress. The use of olive by-products during the growing phase diet of Iberian pigs could be the solution to avoid this stress, but it might have an influence on meat quality. Here, we studied the effect of three different dietary regimens given to Iberian pigs during the growing period (42 kg to 95 kg) on several meat quality traits. A control standard diet group (CD) was compared with two diets based on olive by-products, one incorporating dry olive pulp in the feed (DD) and the other one incorporating olive cake in wet form (WD). The last one consisted of olive cake in a silage presentation offered *ad libitum* and supplemented with a specific feed given once a day in a restricted regimen as the CD and DD diets. We performed meat quality analysis on several traits related with water-holding capacity (thaw loss, (TL); cook loss, (CL); and centrifuge force loss, (CFL)), tenderness (Warner-Bratzler shear force (Sf)), marbling (Vet) and color (CIELab coordinates for luminosity (L), redness (a), and yellowness (b); color indexes Hue (H) and Chroma (C); and myoglobin concentration, (Mb)). ANOVA was made in order to compare growing diets. We found significant differences in several measured traits. CFL was higher in CD than in WD, meaning that meat from pigs fed with standard diet may have lower water-holding capacity than with olive-based diets. According to color, DD samples were paler and less red-colored than CD and WD ones, and myoglobin concentration was also lower in DD. No differences were observed in visual marbling measures, nor in shear force. We conclude that *ad*

libitum supplementary silage should be a good choice to decrease stress due to pre-*montanera* restriction, but dry olive pulp-based diet may have a negative effect on meat quality, since color is important for the consumer.

Keywords: Iberian pig, olive by-products, growing period, meat quality

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DEVELOPMENT OF A DYNAMIC SIMULATION MODEL TO EVALUATE THE INFLUENCE OF FEEDING STRATEGIES ON FATTY ACID COMPOSITION OF PIGS AT SLAUGHTER (S40C07)

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The quality of adipose tissue is directly related with fatty acid (FA) composition which is strongly influenced by genotype, sex, age, live weight and fatness of the pig. Fatty acids are synthesised de novo or of dietary origin thus feed intake, diet composition and energy partitioning may have a major impact. In order to predict the influence of dietary factors on fat and its FA composition a dynamic simulation model was developed. Growth is described by a model of protein and lipid deposition where the latter results from deposition of major dietary FA and de novo synthesized FA. Among other hypothesis, it is assumed that 90% of dietary FA are deposited without modification, and that the composition of de novo synthesized FA corresponds to 48, 29 and 19% of oleic, palmitic and stearic acids, respectively.

Data from 2 animal trials were used to calibrate the model, which was then evaluated by a sensitivity analysis, and by comparing results from simulations with those of controlled experiments, and of selected literature data. Comparison with experimental results showed that prediction of stearic and oleic acids tended to be higher whereas palmitic and linoleic acids tended to be lower than observed, which could be related with FA partitioning among different fat depots. Simulation with literature data showed reliable predictions of palmitic, stearic and linolenic acids ($a=0$, NS; $b=1$, NS) whereas oleic ($a\neq0$, $P<0.05$) and linoleic ($b\neq1$; $P<0.05$) acids showed a tendency to be overestimated at very low (<35%) or very high (>30%) contents, respectively. However, this was related with utilisation of quite uncommon levels (>12%) and oil sources (fish oils, butter). Elimination of these data from dataset leaded to better predictions ($a=0$, $b=1$; NS) for all major FA.

Even though hypotheses used in the underlying model may have a major impact on the outcome validation results indicate adequate backfat FA predictions. Therefore, modelling lipid growth can be a useful tool to assist pig experts assessing the impact of nutrition on

the dietary, sensory and processing qualities of meat, thereby improving profitable feeding strategies.

QUALITY OF MEAT PRODUCED BY IBERIAN AND LARGE WHITE X LANDRACE PIGS FINISHED INTENSIVELY OR IN THE "DEHESA" SYSTEM (S4P01)

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Iberian (IB, n=60) and crossbred Large White*Landrace (F1, n=58) pigs were slaughtered at 160 kg, after finishing under intensive conditions (IN) or on pasture and acorns (EX). Physicochemical properties and sensory attributes of meat were assessed in *Longissimus lumborum* samples. Interactions of genetic group and finishing system were significant (P<0.05) for pH, meat color and cooking loss, but genetic group was the major factor influencing the variables analyzed, with a significant (P<0.01) influence on all meat physicochemical characteristics and sensory attributes. Relative to F1 pigs, the IB had higher mean IMF and marbling score by about 7.9% and 2.2 points (P<0.01), respectively, shear force lower by 10,8 N in EX- and by 17.7 N in IN-finishing, and sensorial tenderness higher by about 1.0 and 1.4 points in EX and IN, respectively. Moreover, meat from IB pigs had higher juiciness, flavor intensity and acceptability and global acceptability in a taste panel. Finishing system affected (P<0.05) most physical characteristics, such that Infinished pigs had higher marbling score by about 0.8 points and lower drip loss at 2 and 9 pm (approximately 2.4% and 3.3%, respectively). Shear force did not differ between finishing systems at 2 days pm, but ageing for 9 days resulted in a 21% reduction of shear force in EX- and 12% in IN-finishing. Chemical composition and meat juiciness and tenderness were not influenced by finishing system, but flavor intensity and acceptability and global acceptability were slightly higher in meat from IN-finished pigs. Meat ageing for 9 days benefited pork quality, improving meat tenderness and color, particularly in pigs finished intensively. Multiple regression analyses indicate that marbling score was the physical

component with the highest influence on all sensory attributes ($P < 0.05$), followed by shear force and cooking loss. Overall, Iberian pigs produced meat with slightly higher pH, much higher marbling and IMF, more intense darker and redder color, lower shear force, and more desirable sensory properties, while the effect of finishing system on meat quality was moderate.

LIPID PROFILE OF INTRAMUSCULAR FAT IN IBERIAN AND F1 LARGE WHITE X LANDRACE PIGS FINISHED INTENSIVELY OR IN THE "DEHESA" SYSTEM (S4P02)

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Iberian (IB, n=60) and crossbred Large White*Landrace (F1, n=58) pigs were slaughtered at 160 kg, after finishing under intensive conditions (IN) or on pasture and acorns (EX). The fatty acids (FA) profile of longissimus thoracis intramuscular fat (IMF) was studied. Animals in IN received a conventional diet while those in EX were finished in the "dehesa" system, in parks of 10 ha with natural pasture, and oak and cork trees (15-30 trees/ha). The IMF was determined by Soxlet and the FA profile by GLC. The activity of enzymes involved in FA metabolism was estimated by substrate/product ratios. The IMF was nearly 3.6 times higher in IB than in F1 (10.81 vs. 2.97%, respectively). Of the 53 individual FA and ratios evaluated, a significant ($P<0.05$) interaction between genetic group and finishing system was detected in 55% of them, especially in FA of the MUFA and PUFA groups. Nevertheless, the effect of genetic group was more pronounced, causing a larger variation among means. Even though higher amounts of MUFA cis-9 were found in IB-IN and IB-EX when compared with F1-IN and F1-EX pigs, the activity of Δ9 desaturase 18 was higher in IB-EX ($P<0.05$). Also, higher amounts of 18:2n-6, 20:4n-6, and 20:3n-9 were found in F1-EX pigs ($P<0.05$), with differences in the order of 8% relative to IB-EX ($P<0.05$). The major differences between genetic groups and finishing systems in the lipid profile of IMF were found mostly in the PUFA group, especially in 18:2n-6.

Keywords: Fatty acids, Iberian pig, Finishing system, Intramuscular fat

CHARACTERIZATION OF CARCASS COMPOSITION AND MEAT QUALITY TRAITS OF ALENTEJANO PIGS FINISHED UNDER FREE-RANGE CONDITIONS - PRELIMINARY RESULTS (S4P03)

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The Alentejano pig is an autochthonous fatty breed from the south of Portugal, traditionally finished under free-range conditions. During fattening, which occurs in fall/winter months, pigs are fed with acorns and grass, being slaughtered at high body weight (≈150kg). Meat and fat of this breed are used to manufacture high quality meat products, including several with the Protected Designation of Origin (PDO) or Protected Geographical Indication (PGI) labels. Despite the impact on final product quality and on productive efficiency, carcass and meat quality of pigs available for manufacture of these products is still poorly characterized.

In this work the carcass composition and physicochemical characteristics of meat from Alentejano pigs raised under free-range conditions was evaluated. In February/March 2017, 541 carcasses of Alentejano pigs (254 males and 287 females) from 11 farms located in the Alentejo region, southern Portugal, were studied. For each animal, the weight of carcass, loins, hams and forelegs, as well as backfat thickness, were recorded. Longissimus lumborum muscle samples were collected for physicochemical analysis.

A high variation was detected for the various carcass and meat quality parameters analysed. Carcass weight varied between 108.1-194.4kg, with heavier carcasses in males than in females ($P<0.001$; 126.6 ± 12.5 vs. 122.3 ± 10.1kg, mean ± SD). The weights of loins, hams, and forelegs averaged 3.71 ± 0.52, 26.5 ± 2.5 and 17.5 ± 1.6kg, respectively.

The weights of hams and forelegs were higher in males than in females (P<0.001), but the loins and hams weight proportion in relation to the carcass did not differ between sexes. The backfat thickness was 5.97 ± 0.84cm. Regarding meat physicochemical parameters, the moisture and ashes were 67.8 ± 2.3 and 1.10 ± 0.11%, respectively. The pH and water loss were 5.70 ± 0.20 and 13.2 ± 3.7%, respectively. Meat colour parameters averaged 40.4 ± 2.9, 13.6 ± 1.8, 7.0 ± 1.3, 27.2 ± 3.0 and 15.3 ± 2.2, for L*, a*, b*, hue angle and chroma, respectively. Saturation index was 0.38 ± 0.05. Total pigments and myoglobin were respectively 55.3 ± 17.1µg/g and 1.43 ± 0.44mg/g. Meat from females showed lower moisture content and water loss (P<0.05) than those from males.

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NITRATES REPLACEMENT WITH NATURAL ANTIOXIDANT IN CINTA SENESE SEMI-RIPENED SALAMI (S4P04)

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In the last decades, concerns about meat and processed meat consumption raised due to their correlation with the onset of several diseases; till, in 2015, WHO classified processed meat products carcinogenic to humans, including them in Group 1. Indeed, in these products, the use of nitrites and nitrates promotes the formation of nitrosamines that are considered harmful compounds. To address the consumer's demand for healthier products, a solution has been identified in replacing nitrates and nitrites with natural antioxidants as food preservatives. So, 3 types of traditional fermented salami were manufactured and analyzed in this study. Group C (n=6) was made by adding 30 ppm of nitrates; group A (n=6) was made replacing the nitrates with a mixture of grape seed extract and olive pomace; group B (n=6) was made using a mixture of chestnut and olive pomace as nitrates replacement. Preliminary analysis on salami were carried out for fatty acids (FA) profile, lipid and cholesterol content. Moreover, a trained panel of 8 judges performed a quantitative-descriptive sensorial analysis. Results showed that, although the addition of an oleaginous element like the mixtures, no relevant modifications were observed in the total lipid content. Similarly, the FA profile of A, B and C was equivalent with the only exception of the arachidonic FA, which resulted significantly higher in A and B salami, likely due to the presence of the olive pomace. As no significant differences were found in FA profile as well as for SFA, also the cholesterol content resulted similar for all the treatments. Concerning the sensory analysis, among the attributes (oiliness, abnormal colors, texture, color uniformity, characteristic flavor, off flavor, salty, rancid, abnormal flavor, hardiness, juiciness), only for texture and color uniformity, judges assessed significant differences, being the former lower scored in A group respect to B; while for the latter, C sausages resulted in a better score than A and B ones. In conclusion, preliminary results showed that both the mixtures had not caused any significant change on lipid-correlated attributes of

salami, as well as no important sensorial attributes resulted to be affected by the replacement.

Keywords: Grape seed extract; chestnut extract; fat; fatty acid profile; cholesterol

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CONSUMERS ACCEPTABILITY OF INNOVATIVE PRODUCTS FROM MAJORCAN BLACK PIG ENRICHED WITH VEGETAL INGREDIENTS (S4P05)

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The Majorcan Black Pig (MBP) is an untapped breed from Mallorca Island, in the Mediterranean Sea. Due to its high degree of rusticity, it is suitable for extensive production systems. The aim of the study was to know the overall liking of consumers tasting different types of MBP patties to identify new market niches for this meat. To achieve this, bioactive compounds such as polyphenols and β-glucans were added to the patties, by including respectively blueberries (*Vaccinium corymbosum*) and mushrooms (*Boletus edulis*) in their composition. The study was carried out in Barcelona. A panel of 120 consumers was selected to test five types of MBP patties, three innovative treatments and two controls: MBP patties (A), MBP with porcini mushrooms (B), MBP with blueberries (C); beef and pork (D) and beef (E). The experimental design consisted of two tests: (1) Blind test: consumers tasted the five types of patties (overall liking on a scale of 1 (dislike extremely) to 9 (like extremely)). (2) Informed test: Consumers repeated the sensory test, but with information about the origin of the meat, production system and potential beneficial effects of the added healthy ingredients (improvement of the immune system in B and prevention of cardiovascular diseases in C). The results showed that there were no significant differences according to age and gender. The MBP patties had a significantly higher average acceptance than the rest (6. 60 in the Blind test and 7.06 in the informed test) with respect to its sensory attributes. Also, the information provided to the consumers had a positive effect of their level of acceptance in this product. However the type of patties with vegetal ingredients were scored significantly lower than the other types of patties, both in the Blind and Informed test. These results would indicate that consumers did not like so much the sensory characteristics of these patties (texture and flavor). In conclusion, there is a need to provide clear and understandable

information to the consumers about the differential characteristics of the products, ensuring sensory quality.

Keywords: Consumer acceptability, Majorcan Black Pig, healthy patties, polyphenols.

Acknowledgments: This work has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 634476 (Project acronym: TREASURE). The content of this abstract reflects only the author's view and the European Union Agency is not responsible for any use that may be made of the information it contains.

BREEDING PROGRAM FOR CARCASS AND MEAT QUALITY TRAITS IN A CLOSED COMMERCIAL POPULATION OF IBERIAN SOWS USING BOARS FROM THE HERDBOOK (S4P06)

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On December 18th, 2014, INIA, AECERIBER, COVAP and La Contienda Foundation started a breeding program for productive traits in Iberian pig. The aim of the breeding program is the genetic evaluation for growing, carcass composition and meat quality traits applying BLUP-Animal model methodology. Meat quality phenotypes will be used for searching candidate genes through custom SNPs panels. Transcriptomic studies will also be performed from liver, muscle and fat samples. The population basis is composed by sows from a farm named La Contienda (Aroche, Huelva), coming from three different herds. These sows are being covered by Herdbook boars from several AI centres. AIs are planned to obtain 30-40 piglets from each boar in order to be evaluated with enough accuracy. Piglets are raised following an extensive breeding system (*cebo de Campo*). At weaning, they are moved to indoor rearing houses until they reach 40 kg of body weight. Then, animals are relocated to growing fences with outdoor zones and limited disposal of dry feed. At the age of 9-10 months, fattening period is started with liquid feed plus seasonal pastures available in large fences of several hectares. Some measures are being recorded at every production batch, including reproductive data (number of total born, born alive and weaned piglets and weight of weaned piglets), growth data and ultrasound scanning of backfat thickness and loin area at different ages, and slaughter data (carcass weight and length, backfat thickness at 14th and 10th ribs, ham, shoulder and loin weights, ham length; shank diameter, and 24h post-mortem pH). Subcutaneous backfat and loin area also being sampled in order to analyse fat and meat quality traits (fatty acid profile, intramuscular fat, marbling, water holding capacities, shear force, myoglobin content, CIELab colour, collagen content) and

also for future transcriptomic analyses. At the moment, 4 mating batches have been finished. The first batch has already been slaughtered and sampled and laboratory analyses are now being carried out. Slaughter of the second batch is planned for the end of October, 2017. A fifth batch is expected to be born in January, 2018. In the meantime, weight controls of the other batches are being carried out.

Keywords: Iberian pig, Herdbook, breeding program, meat quality

EFFECT OF SMOKING ON THE PHYSICOCHEMICAL CHARACTERISTICS OF DRY-CURED IBERIAN LOIN (S4P07)

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Smoking of food is one of the oldest methods of food preservation, being still widely used to help to preserve some foods, Iberian loin not usually being included. Beside, the smoking process is also used due to the notable influence on the sensory characteristics of the products. This research has evaluated the inclusion of two smoking treatments in the processing of dry-cured Iberian loin, trying to modify the product in order to provide consumers with an alternative product, while also, at the same time, keeping its traditional character. The objective of this research was to determine the effect of two different duration smoking treatment (0h, 9h and 18h) on physicochemical characteristics of Iberian loins. 105 loins were processed in a traditional way, but including a smoking treatment for 90 of them, that were smoked using wood from holm-oak (*Quercus ilex*) just before the ripening step. Based in the different smoking treatment, three batches of loin samples were obtained: non-smoked control, a batch of loins that suffered 9 hours of smoking and a third batch with 18 hours of smoking. Loin samples were obtained at three stages of the process: raw, 72 hours after smoking and after 45 days of processing, concurring with the final product. The following measurements were analyzed: moisture content (ISO 1442:1997), pH, water activity (Novasina), L*, a *, b * color parameters (Minolta CR-300), hardness (TA.XT2, SMS) and TBA (Jørgensen and Sørensen, 1996). Data was analyzed with ANOVA test and Tukey test when differences were significant by SPSS software. The results showed that, apart from differences among processing stages, only few differences in a* value were found comparing the different treatment of smoking. Values of a* color on loins with g18h of smoking were smaller than on control and 9h of smoking ones. It can be concluded that the inclusion of a smoking stage in the Iberian loin dry-curing process did not cause marked differences in the physicochemical characteristics of the product.

Keywords: Iberian pig, smoking, loin, physicochemical characteristics.

EFFECT OF FEEDING MANAGEMENT ON THE EFFICACY OF LONG-TERM MALE IMMUNOCASTRATION PROTOCOLS SPECIFICALLY DESIGNED FOR IBERIAN PIGS (S04P08)

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Standard male immunocastration (IC) protocols should be adapted to the long life cycle of Iberian pigs before the expected implementation of a voluntary end of male pig castration in the EU. Our research team developed long-term, 3-dose IC protocols for pre-pubertal and pre-finishing male Iberian pigs. The efficacy of these protocols seemed to be influenced by nutritional level and stress, which are closely interdependent during the feed-restriction periods typical of Iberian pig production. This study aims to improve the efficacy of these pre-pubertal and pre-finishing male IC protocols through a short-term increase in feeding intake.

Pigs were raised in a conventional, concentrate-based extensive system. Late-immunocastrated males (L-ICM group; n=47) were immunized against GnRH at 11, 12 and 14 months of age. Early-immunocastrated males (E-ICM group; n=39) were immunized at 4.5, 5.5 and 9 months of age. Intact males (n=5) were used as general controls. All pigs were slaughtered at 16 months of age. Approximately half of each IC group were submitted to a 15-day *ad libitum* feeding period starting at the 3rd vaccination (Treated subgroups; 23 L-ICM and 19 E-ICM), during which hopper-type feeders were set in large corrals to minimize competition and stress. The remaining IC males belonged to Control subgroups.

A 100% efficacy was reached by the feeding-modified Late protocol, as all Treated L-ICM had <150-g testes (which was the threshold for blood testosterone presence in our earlier studies). In contrast, 4/24 Control L-ICM, 6/20 Control E-ICM and 8/19 Treated E-ICM had >150-g testes. Poor-responding E-ICM exhibited testicular growth after atrophy. Blood testosterone data are not yet available. Excluding the poor responding males (>150-g testes), Late ICM were heavier at 14 months of age and had heavier loins at slaughter than

Early ICM, but the latter had greater backfat thickness and loin intramuscular fat content. In conclusion, a short-term nutritional level increase can be used to improve the efficacy of late (pre-finishing) male IC protocols in Iberian pigs. On the other hand, the pre-pubertal protocol could not be improved by feeding management intervention. Consequently, new research is being conducted to develop a feasible early protocol.

Keywords: GnRH immunization; reproductive tract; carcass composition; free-range system; restricted feeding

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EFFECT OF THE IMMUNOCASTRATION PROTOCOLS ON CONSUMERS' ACCEPTABILITY OF FRESH LOIN FROM IBERIAN PIGS (S4P09)

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One alternative to surgical castration of pigs is the immunocastration. Due to the Iberian pig long life cycle, the standard immunocastration protocol was modified to 3-dose of vaccine. The aim of the present work was to evaluate the influence of two immunocastration protocols: pre-pubertal (P) and pre-finishing (F) on the acceptability of fresh loin of Iberian pigs by consumers. Twenty male pigs were immunocastrated (10 per group) and were slaughtered in commercial conditions with a live weight of 162.0+6.3 kg on pre-pubertal and 161.4+5.5 kg on pre-finishing pigs. The loin was frozen and the samples were thawed at 4ºC the day before the study. Meat samples were cooked in an oven pre-heated at 200ºC until reach the internal temperature of 76ºC. A total of 100 consumers representative of the Spanish population participated in this study in a big city. The evaluation was performed in controlled conditions in sessions of 20 consumers each. For each loin consumer scored in a 9-point scale (from 1: 'I dislike extremely' to 9:'I like extremely' without the intermediate level 5:'neither like nor dislike') the tenderness, odour, taste and overall acceptability. Statistical analysis was performed using SAS software considering the treatment as fixed effect, session as blocking variable and consumer as random effect. In the conditions of the present experiment, no differences were found between the two immunocastration protocols for any of the sensory attributes of fresh loins evaluated by consumers.

Keywords: pig castration, sensory, quality, fresh meat

DIFFERENCES IN GROWTH RATES OF MUSCLE TISSUE AND FAT IN HAM, LOINS AND SHOULDER BETWEEN CRNA SLAVONSKA PIGS FROM TWO REARING SYSTEMS (S4P10)

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Crna slavonska (Black Slavonian) is low productive and late maturing pig with excellent meat quality traits and resistant to environmental influences. It is often reared in extensive conditions like pastures and woods. Sometimes, Crna slavonska pigs are also kept in various semi-extensive conditions in pens with some free space etc. However, the differences that arise from alterations of production systems are still not sufficiently investigated. Comparing indoor and outdoor production system offers the greatest environmental contrast and provides a solid basis for studying the differences in growth characteristics, carcass and composition. The experiment was carried out on 180 Crna Slavonska (CS) pigs. The animals were distributed into two rearing systems. A total of 80 pigs (40 gilts + 40 barrows) were kept indoor (deep litter) and 100 pigs (50 gilts + 50 barrows) were reared in the outdoor system. Starting at the age of three months, pigs from both experimental groups were sacrificed for the analysis of muscle and fat growth in ham, loins and shoulder by the series of subsequent dissection trials, covering a total fattening period of 15 months. Our results show that devolopent of selected cuts and belonging tissues grow at similar rates until the age of 6 months when significant differences in all monitored traits occur between the pigs from two different rearing systems.

Keywords: pig, local breed, carcass traits, growth

EFFECT OF RESTRICTION FEEDING SENSORY QUALITY OF PORK LOINS (S4P11)

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Restriction strategies on the feeding of pigs might modify the composition of the final product and its sensory properties. The objective of the present study was to determine the effect of the restriction feeding on the sensory characteristics of the meat. For this purpose 48 (Pietrain x (Large White x Landrace)) gilts fed 4 different feeding regimes: 1) ad libitum (AL) during all fattening (AL-AL) period; 2) AL between 30 and 70 kg followed by restriction (84% of AL) until 120kg (AL-RV); 3) restricted (78% of AL) between 30 and 70 kg followed by AL until 120 kg (RV-AL); 4) low energy diet (-10%) between 30 and 70 kg followed by AL until 120 kg (RE-AL). Eight trained panellists evaluated the odour (meat, pig, abnormal), flavour (meat, pig, abnormal, acid, sweet, and metallic) and texture (hardness, initial juiciness, final juiciness, tenderness, fibrosity and chewiness) attributes of cooked loins (oven at 200ºC until reach 76ºC internal temperature) in 10 sessions. In each session each panellist evaluated monadically 4 samples (one of each treatment) served following a design to avoid first sample and carry-over effect. The model included treatment, session and panellist within session as effects and differences between least squared means were determined after applying Tukey test. There were significant differences in acid flavour, being higher in RV-AL than in RE-AL. Also the hardness was significantly ($P<0.05$) higher in AL-RV than in AL-AL, indicating that the restriction on volume during finishing could negatively affect at the hardness of the meat. In conclusion, few sensory differences can be found in loins from pigs fed differing feeding strategies although a restriction in volume during finishing may produce harder loins than those from pigs fed ad libitum during all the growth period. Also, restriction in volume at the first phase of fattening produce more acid taste than energy restriction and Ad-libitum feeding regime.

Keywords: Feeding strategies, pork, sensory, tenderness

RESPONSE IN CARCASS CHARACTERISTICS OF WINDSNYER PIGS FED ON INCLUSION LEVELS OF POTATO HASH SILAGE (S4P12)

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The objective of the study was to determine response in carcass traits and primal pork cuts of Windsnyer pigs fed on diets containing different inclusion levels of potato hash silage. Thirty-six growing Windsnyer pigs with slaughter weight of 36 kg ± 4.89 (mean ± SD) that were previously assigned to six experimental diets containing 0, 80, 160, 240, 320 and 400 potato hash silage g/kg DM were used in the present study. The experimental diets were derived from mixing a summit diet containing no potato hash silage and a dilution diet containing 400 potato hash silage/kg in different proportions. Six pigs were fed on each diet *ad libitum* for five weeks (Chapter 3) before they were slaughtered. Carcass traits and primal pork cuts were measured. There was a quadratic increase in warm carcass weight (P >0.001) and cold carcass weight (P >0.001) as inclusion levels of potato hash silage increased. A linear (P >0.05) increase in dressing percentage was observed. The cooler shrink decreased quadratically (P >0.05) as inclusion levels of potato hash silage increased. Increasing levels of potato hash silage resulted in linear decrease in shoulder fat (P <0.05) and carcass length (P >0.05). There was a negative linear (P >0.01) relationship between eye muscle area and inclusion of ensiled potato hash increased. There was a positive quadratic relationship (P <0.05) between hindquarter length (HQL) and inclusion levels of potato hash silage. The HQC decreased linearly (P >0.05) as the inclusion levels of potato hash silage increased. There was linear increase and decrease in dorsal fat thickness at last rib (DFT2) (P<0.05) and dorsal fat thickness at last lumbar vertebra (DFT3) (P<0.05) as potato hash silage increased,

respectively. There was a linear decrease (P <0.01) in backfat thickness as inclusion levels of potato hash increased. Carcass weights, dressing percentage, and backfat thickness were related to inclusion levels of potato hash silage. Most the carcass traits and primal pork cuts are assumed to be related to genetics of the Windsnyer pigs rather than diets.

Keywords: backfat thickness; carcass traits; potato hash silage; primal pork cuts; Windsnyer pigs

CARCASS QUALITY AND FATTY ACIDS PROFILE OF THE FATTENERS OF SWALLOW-BELLY MANGALITSA BREED REARED IN OUTDOOR SYSTEM (S4P13)

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The objective of this study was to determine carcass quality of fatteners of Swallow-belly Mangalitsa breed reared in outdoor system. In *m. longissimus dorsi* (MLD) samples chemical composition, cholesterol content and fatty acids profile was determined. The study included 22 castrated males reared in the oak forest from the early spring to late autumn, with minimal corn harvest (approx. 0.5 kg per day). During the winter, the fatteners were kept in wooden stables and fed with cereals (corn and barley mixture in a ratio of 70:30, approx. 3 kg per day). The data was carried out by statistical package SAS 9.1.3 (SAS Inst. Inc., 2002-2003) and basic statistical parameters are showed (Mean±SD). At the end of fattening, the pigs were about one year old, and slaughtered at 92.0±16.7 kg live body weight. The average lean content in the carcasses was 35.9±2.8 %, while the content of intermuscular fat in MLD was 6.2±1.2 %. In the MLD samples average content of proteins, water, fat and ash were 20.7±0.5 %, 70.4±0.5 %, 7.7±0.5 % and 1.0±0.1 %, respectively. Average cholesterol content was 41.4±3.8 mg/100g. Shares of saturated fatty acids (ΣSFA) in MLD fat was 35.6±1.2 %, monounsaturated fatty acids (ΣMUFA) was 56.6±1.8 % and polyunsaturated fatty acids (ΣPUFA) was 6.9±1.2%. Within ΣSFA the most common was palmitic acid (C16:0, 24.7±0.6 %), wile within ΣMUFA it was oleic acid (C18:1c-9, 46.9±1.1 %) and within ΣPUFA it was linoleic acid (C18:2n-6, 5.6±1.0 %). ΣPUFA and ΣSFA ratio was 0.2±0.0, while omega-6 and omega-3 ratio was 25.1±5.6. Showed ratios are not desirable from the nutritional aspect of human diet.

Keywords: carcass quality, chemical composition of meat, cholesterol, fatty acids profile

EFFECT OF CASTRATION METHOD ON GROWTH RATE OF INDIGENOUS PIG BREED MANGALITSA SWALLOW BELLIE (S4P14)

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Extremely rich genetic funds of animals obtained by natural selection through the centuries are very important resources of Serbia. In Serbia, surgical castration of male animals in first week post partum is a usual practice to avoid boar taint. Considering that Mangalitsa sows are good mothers and most aggressively protect the piglets we tested the alternative to physical castration. The aim of this study was to examine the effect of method of castration (physical or immunocastration) on growth potential of indigenous pig breed Mangalitsa Swallow Bellied. Investigation included surgically castrated (SC; n=12) and immunocastrated (IC; n=11) male pigs, fed *ad libitum* a feed mixture with 12-13 MJ ME/kg; 13-15% crude protein (two-phase feeding). The experiment started at 24.4 weeks of age when average body weight (ABW) of SC pigs was 24.3 kg and of IC pigs 28.4 kg. Immunocastrates were vaccinated with Improvac® (Zoetis-Pfizer) at 39 (V1) and revacinated at 46 (V2) weeks of age (WA). Pigs were slaughtered 6 weeks after V2. Until V1 when IC are actually entire males, growth rate was slightly lower in IC than SC pigs (446 vs. 495 g/day, respectively). Established difference was statistically significant (P=0.03). In the period between V1 and V2 growth rate was alike in IC and SC (454 vs. 448 g/day, respectively; P=0.92). Overalluntil V2, there was no difference in ABW between IC and SC pigs (99.2 vs. 100.2, respectively; P=0.89). The maximal growth rate (689 vs. 683 g/d for SC and IC, respectively) was observed between 35 and 39 WA. In the period after V2 until the end of the fattening period growth rate was significantly higher (P=0.002) in IC than SC pigs (548 g vs. 392 g, respectively) in agreement with higher feed intake of IC than SC (3.2 vs. 2.7 kg/pig/day recorded on a pen basis). Present results on the indigenous Mangalitsa breed confirm what has been previously

demonstrated in modern breeds, i.e. that after the effective immunisation the pigs increase their feed intake and consequently growth rate.

Keywords: pig, surgically castrated, immunocastrated, fattening abilities

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FATTY ACIDS CONTENT OF *M. LONGISSIMUS DORSI* OF MORAVKA PIGS (S4P15)

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Fatty acids composition of *m. longissimus dorsi* (MLD) of Moravka pigs was analyzed considering also the effect of sex and body weight of pigs at slaughter. Pigs were reared in facilities with the open-aire section and fed a complete feed mixtures adapted to the stage of growth (from 20-60 kg mixture I: 15.50% of crude protein (CP) and 12.95 MJ metabolisable energy (ME)/kg,; from 60-120 kg mixture II: 13.00% CP and 13.05 MJ ME/kg). The study included 21 pigs (12 castrated males and 9 females). Pigs were slaughtered at 339±30 days of age and 112.8±19.9 kg of live weight. MLD of Moravka pigs had the following fatty acids composition: 41.8 % saturated fatty acids (ΣSFA), 54.0% monounsaturated fatty acids (ΣMUFA) and 4.1% polyunsaturated fatty acids (ΣPUFA) resulting in value 0.10 for the ratio of polyunsaturated to saturated fatty acids (P/S). Fatty acids C16:0 and C18:0 represented the largest share of ΣSFA (61.7 and 34.3 %, respectively), C18:1 and C16:1 the largest share of ΣMUFA (90.1 and 7.1%, respectively), and C18:2 the largest share of ΣPUFA (93.5%). With regard to sex effect, castrated males exhibited higher content of saturated fatty acids C14:0 (1.42 vs. 1.26, P=0.046) and C18:0 (15.07 vs. 13.38, P=0.025) than females. Significant effect (P<0.05) of body weight was observed on some fatty acids; thus 1 kg increase of slaughter weight was accompanied with 0.036% decrease of linoleic acid (C18:2n-6), 0.038% decrease of total content of polyunsaturated acids (ΣPUFA), 0.020% increase of palmitoleic acid (C16:1cis-9), 0.067% increase in total content of monounsaturated fatty acids (ΣMUFA), 0.003% increase of C17:0. Ratio P/S decreased by 0.001 unit per kg increase of slaughter weight. In agreement with their high relative content, a strong correlation (r_P=0.79 and r_P=0.77) was found between C16:0 and C18:0 and total content of saturated fatty acids (ΣSFA), between C16:1cis-9 and C18:1cis-9 and

ΣMUFA (r_P=0.80 and r_P=0.98, p<0.001), and between linoleic acid (C18:2n-6) and ΣPUFA (r_P=0.99, p<0.001).

Keywords: indigenous pig breed, sex, muscle tissue, fatty acids

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OPTIMIZATION OF A CRYOHISTOLOGICAL TECHNIQUE TO PERFORM MICRO-MORPHOMETRIC ANALYSES OF INTRAMUSCULAR FAT MARBLING IN THE IBERIAN PIG (S4P16)

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Intramuscular fat is positively associated to meat quality. Besides chemical analysis of intramuscular fat, microscopic image analysis might allow for a detailed assessment of intramuscular fat distribution and changes in adipocyte size and number. These features, which could be different for a given intramuscular fat percentage, could facilitate comparisons between growth stages, feeding systems and swine breeds, e.g., Iberian or other fatty pigs *vs.* commercial, fast-growing breeds. On the other hand, certain differences in microscopic marbling structure could account for important pork quality traits. The aim of this work is to adapt a cryohistological technique to perform microphotometric studies involving intramuscular fat deposition in pig muscle. For these purposes, a preliminary study involving Iberian pigs (*Retinto* strain, *Valdesequera* line) finished in "*montanera*" system has been carried out. Animals were previously fed with three diets differing in fibre content (control, moderate and high) during the pre-finishing stage (*pre-montanera*) and then were submitted to *montanera* (free-range acorn feeding system). Histological studies were performed in 1 cm samples excised from specific and consistent locations within a central stripe taken from the medial to the lateral surfaces of the *Longissimus dorsi* muscle at the level of the 10th intercostal space. These segments, obtained from frozen loin pieces, were fixed in paraformaldehyde and then cryoprotected in a sucrose and gelatin solution. Next, sections were embedded, and 30-µm thick cryosections were obtained and stained with Sudan III and Methylene blue. Microphotographs of the sections were analysed by using an image analysis software. Adipose tissue area and number and mean area of adipocytes within the muscle were quantified. The experimental outcome shows that this technique is feasible and prevents the formation of ice crystals. Therefore, it can be used instead of the classic paraffin-inclusion method, thus avoiding tissue dehydration. In addition, muscular and fat tissues were easily discriminated for morphometrical

measurements. Preliminary results suggest that the *premontanera* high-fiber regime resulted, after *montanera*, in smaller adipose tissue area and adipocyte number in comparison with the other two groups, although adipocyte size did not differ. Moreover, these results correlate with intramuscular fat quantified by chemical methods.

Keywords: adipocytes, *Longissimus dorsi* muscle, image analysis, meat histology

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INFLUENCE OF FEEDING ON PERFORMANCE AND BACKFAT FA COMPOSITION OF IBERIAN X DUROC PIGS RAISED UNDER HEAT STRESS CONDITIONS (S4P17)

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Climate change and the consequent rise in environmental temperature may affect performance of Iberian pigs. Diets with low heat increment could help to counteract these negative effects while keeping carcass quality. The influence of dietary substrate (starch *vs.* fat) and of rationing plan (*ad libitum vs.* restricted) on productive performance, carcass quality and backfat fatty acid (FA) composition of Iberian pigs housed under heat stress conditions was evaluated. Seventy-two Iberian x Duroc crossed barrows of 50kg bodyweight were submitted during 11 weeks to an indoors temperature of 32ºC and 25ºC for 6h and 18h, respectively. A factorial 2X2 design with 2 diets combined with 2 rationing plans were used. A basal diet enriched with corn starch was used as a control, and high-oleic sunflower oil (5%) was used to replace starch on test diet. Both diets were distributed *ad libitum* or according to a restriction plan. Pigs were slaughtered at the end, their carcasses were evaluated and, meat and backfat samples were taken to determine the FA composition. Pigs *ad libitum* fed consume more (3.28 vs 2.90 g/d; P<0.01), grew faster (855 vs 737 g/d; P< =.001) achieving a high bodyweight (136.7 vs 124.5 kg; P<0.05), and showed a better feed conversion (3.91 vs 4.17; P<0.02). Pigs fed on starch diet showed a high feed intake (3.21 vs 2.97 kd/d; P<0.01), and poorer feed conversion (4.19 vs 3.89; P<0.02) whereas growth performance remain unaffected. Backfat depth *in vivo* and at slaughter was high (P<0.01) whereas lean meat was lower (23.8 vs 33.1%; P<0.01) on pigs *ad libitum* fed. Backfat FA compositon was strongly affected by the energy source: palmitic, stearic and linoleic acids were higher on pigs fed on a starch diet whereas oleic acid was higher (P<0.001) on pigs fed high-oleic sunflower oil (P<0.001). *Ad libitum* feeding improves growth performance but also leads to heavy and fatty carcasses of pigs housed under heat stress conditions. Replacement of starch by high-

oleic sunflower oil does not affect performance but it allows to a FA composition that seems more adequate for dry-cured ham processing.

Keywords: pig, heat stress, feeding, fatty acids

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COLOUR STABILITY DURING PROLONGED STORAGE IN DIFFERENT PACKAGING CONDITIONS OF DRY FERMENTED SAUSAGES FROM IBERIAN PORK (S4P18)

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Chorizo "sarta" and salchichon "sarta" are two typical dry-fermented sausage with U-shape from Iberian pig. The differences between them are due to their formulation, since the chorizo “sarta” includes paprika in the mixture.

40 units of chorizo and 40 units of salchichón ¨sarta¨ were packaged in different gas atmosphere conditions i) vacuum packaging (Batch 1) ii) 70% N2+ 30% CO2 (Batch 2) iii) 100 N2 (Batch 3) iv) 70% Argón + 30% CO2 (Batch 4), and were stored under refrigeration (4□1ºC) during twelve months. The evolution of several parameters related to colour surface (L*, a*, b*, Chroma and Hue angle) were studied all throughout storage period.

There were no differences for luminosity (L*) among packaging treatments for salchichón samples (P>0.05), but in chorizo “sarta”, batch 1 (vacuum) showed highest L* values after 12 months of storage, while the lowest values corresponded to the batch 4 (70% Argón + 30% CO2). Red colour intensity (a*) significantly decreased for chorizo ¨sarta¨ in all groups, from initial values of 16.76±0.45 to final values ranging 12.85-14.61□0.34-0.44. With respect of differences among packaging systems of chorizo, batch 1 (vacuum) showed the highest a* and C-values after 12 months and batch 3 (100% N2) the lowest, indicating more intense oxidation reactions affecting the pigment of samples packed in this gas composition.. With respect of salchichón ¨sarta¨, samples which were packaged with a mixture of 70% N2 + 30% CO2, showed a higher intensity of red color (a*) and color saturation (C) after 12 months of storage, and those packaged with 70% Argon + 30% CO2, the lowest values of the parameters a* and C obtained at the end of this period (P<0.01).

The results obtained in this study suggest that the colour of chorizo and salchichón ¨sarta¨ could be maintained for longer than 12 months with all the packaging systems studied. With respect of the type of gas atmosphere, in the case of chorizo, the vacuum packaging was that favoured a better appearance of the product, whereas for salchichón, the gas atmosphere consisting in 70% N2+30% CO2 was the most convenient.

Keywords: chorizo "sarta", salchichón "sarta", modified atmosphere packaging, colour

LOW-PROTEIN DIET FOR IBERIAN – DUROC CROSSBRED PIGS: EFFECTS ON SOME MEAT QUALITY TRAITS (WATER HOLDING CAPACITY AND COLLAGEN AND MYOGLOBIN CONTENT) (S4P19)

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Duroc x Iberian crossbred pigs are not able to fulfil the minimum slaughter age stipulated in the current Iberian Quality Standard (RD 4/2014) with an adequate carcass weight due to their higher growing rate. A protein restrictive diet supplied during the growing phase may decrease this growth rate without compromising meat quality. On previous experiments, we observed that although meat from animals fed using low protein diet had higher thaw water losses, this diet did not significantly affect other meat quality traits. Here, we deepen in our previous results analyzing the effect of a low protein diet on other quality traits: water-holding capacity measured by centrifuge force losses (CFL, %), myoglobin concentration (Mb, mg/g) and collagen content (Col, %). These traits were measured in a total of 61 crossbred pigs fed with two different growing diets (control, C and low protein, LP). The individuals were slaughtered at two different weights (95 and 160 kg) in two consecutive years. First, we performed Pearson correlations between the traits measured on the previous experiments (shear force, thaw and cooking losses and Minolta color) and CFL or Mb. We found significant correlations among water loss traits (thaw loss, cook loss and centrifuge force loss) and between myoglobin content and color traits (L, a, Hue and Chroma). Myoglobin content was higher correlated with redness score (r = 0.55) and Hue (r = – 0.64). We also performed ANOVA of a linear model using growing diet, slaughter weight and slaughter year as fixed effects. No significant differences were observed for any trait (CFL, Mb and Col) between growing diets. On the other hand, CFL was significantly lower in 160 kg slaughter batches, meaning that “younger” meat loses more water, and collagen content was significantly higher in 160 kg batches. We also

observed an effect of the slaughter year in both myoglobin and collagen content, which could be possibly due to sampling differences or environmental variations. These results support our previous findings about the non-influence of a low-protein growing diet in overall meat quality.

Key words: Iberian pig, low protein, growing period, meat quality

CHARACTERIZATION OF THE NUTRITIONAL QUALITY OF M. SERRATUS VENTRALIS FROM IBERIAN PIGS OF VALDESEQUERA LINE UNDER DIFFERENT PRODUCTION SYSTEMS (S4P20)

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The Iberian pig is a rustic pig breed reared in the southwest of the Iberian Peninsula that includes several different genetic lines. Valdesequera line, belonging to the Retinta or ColoradaExtremeña strain, is one of the most widespread today. Two of the main production systems of the Iberian pig are Montanera (the typical free-range rearing system of the Iberian pig, from November to January, and a nutritional strategy based on acorns and grass) and “cebo de campo” (outdoors reared system and nutrition based on a combination of acorns, grass and supplemented with commercial fodder due to the limited productionof natural resources). Fresh meat consumption from Iberian pigs has importantly increased in the last years and meat pieces from these pigs are very appreciated by consumers.

The aim of this study was to determine the effect of the feeding system on the nutritional quality of fresh meat known as “Presas” (m. Serratus ventralis) from Iberian pigs of the Valdesequera line under two different production systems, extensive feeding or “cebo de campo” vs. Montanera. For this purpose, the samples were divided into two batches: i) “Presas” (m. Serratus ventralis) from Iberian pigs fed in Montanera acorn (n = 10) and ii) “Presas” from Iberian pigs fed with concentrated feed (n = 10). The following analyses were carried out: instrumental color (CIE L, a*, b*), proximate composition (humidity, protein and intramuscular fat content) and fatty acid profile determination of intramuscular fat.

The weight of the “presas” of both groups were similar: 610.1 ± 68.8 g for the “Montanera” muscles and 615.6 ± 104.7 g for the concentrated feed batch. Instrumental color of muscles was not affected by the type of feeding of the animals. Similarly, the proximate composition: humidity, protein and intramuscular fat content were not

significantly modified by the differences in the feeding system. However, the different production system had clear effect on the fatty acids composition of the intramuscular fat.. The Montanera batch had a significantly higher proportions of C18: 1 and C18: 3 and significantly lower proportions of C17: 0, C17: 1 and C18: 0 than those pigs which received a commercial feeding, reflecting the acorn fatty acid profile and the C18: 3 richness of the grass. This effect has been previously demonstrated for meat pieces important for the production of dry-cured meat products: ham, shoulder and loin; but in the case of fresh meat, it could also influence the flavour or juiciness perception of meat after cooking.

Key words: Montanera, extensive feeding, nutritional quality, m. *Serratus ventralis*

CHARACTERIZATION OF SUBCUTANEOUS FAT FOR DIFFERENT IBERIAN PIG LINES REARED IN MONTANERA SYSTEM (S4P21)

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Several researches have demonstrated that production systems influence on meat quality attributes which are mainly determinated by fatty acids profile from adipose tissues and antioxidant composition. Iberian pigs in Montanera are fed with acorns and herbage, which provide to the meat differentiating elements that improve its quality. Due to Iberian pig breed is composed by several genetic lines with differential characteristics, the aim of this work was to study the characteristics of subcutaneous fat from animals of three Iberian pig lines.

In order to study the effect of three Iberian pig lines (Lampiño, Torbiscal and Valdesequera) in subcutaneous fat (SF) quality, 36 pure breed animals (12 per line) were free reared under Montanera system (typical free-range system from SW of Spain and feeding with a acorns and herbage based diet) and slaughtered at 150±10 kg live weight. Subcutaneous backfat samples were removed, and instrumental colour, Vitamine E content and fatty acid profile were determinate.

Concerning instrumental colour, no significant differences ($p>0,05$) were found in CIEL a*,b*, C and H parameters; nevertheless CIE L* values were significantly ($p<0,01$) higher for Valdesequera than Lampiño line. Vitamin E contents were affected by line, given that Lampiño line showed the highest content of α-tocopherol, even though □-tocopherol values were similar for the three lines. Regarding to fatty acid profiles, Lampiño pigs showed the significantly highest values of palmitic (C16:0), linoleic (C18:2) and total polyunsaturated (PUFA) acid, as well as the lowest oleic (C18:1) and total monounsaturated (MUFA) acid values. Valdesequera line showed lower content of total saturate fatty acids (SFA) than Lampiño.

These results shows significant differences in fat quality between Iberian pig lines. Furthermore, the line can be a factor to

consider in the study of Iberian pig fat quality, thus Lampiño line presented the best use of α-tocopherol available, mainly in the herbage.

Keywords: Iberian line, fatty acid, antioxidant, Montanera system

Session 5. Technology of Reproduction

CHARACTERISTIC EXPRESSION OF BH3-INTERACTING DOMAIN DEATH AGONIST (BID) AND BCL2-ASSOCIATED X PROTEIN (BAX) IN FOLLICULAR GRANULOSA CELLS OF MANGALICA OVARIES (S5OC01)

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In mammals, follicular atresia is predominantly regulated by granulosa cell apoptosis. However, detailed intracellular signaling pathway of apoptosis in granulosa cells has not yet been elucidated. We examined changes in the expression of BH3-interacting domain death agonist (BID) and Bcl2-associated X protein (BAX), which promote the cell death ligand and receptor mediated process in mitochondrion dependent type II apoptosis, in porcine granulosa cells during follicular atresia. BID and BAX mRNA and protein levels were determined by RT-PCR and Western blotting, respectively. Levels of BID and BAX mRNAs and proteins were markedly increase in granulosa cells of early atretic follicles compared to those of healthy follicles. In situ hybridization and immunohistochemical staining revealed that mRNAs and proteins of BID and BAX were present in the granulosa cells though only negative or traces were found in healthy follicles, but strong staining were noted in atretic follicles. Then, to confirm the proapoptotic activity of BID and BAX in granulosa cells, we examined the effect of RNA interference of BID or BAX on apoptosis using an ovarian granulosa cells. By RT-PCR and Western blotting, spontaneous expression of BID and BAX was detected in the cells. We suppressed BID and BAX mRNA expression in the cells using siRNA technique. When BID or BAX mRNA was suppressed, a significant decrease in the apoptotic cell rate was noted. The present results indicate that BID and BAX appear to be signal transduction factors in granulosa cells during follicular atresia and to play proapoptotic roles, and confirm that porcine garanulosa cell is type II apoptotic cell. Then, we compared the BID and BAX expression levels in the ovaries of Mangalica (Hungarian native fatty pig) sows and commercial breed Landrace sows. High expression levels of these factors in granulosa cells of Mangalica sows (small litter size) was noted.

The present findings suggest that follicular granulosa cells may easily die in Mangalica ovaries. Moreover, because BID has a role in enhancing the apoptosis in virus-infected cells, high expression of BID in Mangalica pig may associated with high resistance to viral infectious diseases such as foot and mouth disease in them.

CURRENT STATUS OF OOCYTE CRYOPRESERVATION FOR GENE BANKING IN PIGS (S5OC02)

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Ex situ gene banking by the cryopreservation of gametes has strategic importance in animal husbandry. For the cryopreservation of female germplasm in pigs, we have established a high capacity protocol which enables the vitrification of a large groups of immature oocytes in microdrops. In 2013, we succeeded to produce live piglets from cryopreserved porcine oocytes for the first time after in vitro maturation, fertilization and subsequent embryo culture of vitrified ova. However, despite of high survival and nuclear maturation rates, normal cytoplasmic maturation and normal fertilization, the competence of vitrified oocytes to develop to the blastocyst stage is still compromised. The exact mechanism behind the reduced competence of vitrified oocytes is yet to be clarified. Our recent research revealed that optimization of the temperature during treatment of immature oocytes with cryoprotectant agents at 25 ºC and the duration of treatment with vitrification solution for 30 sec could significantly improve blastocyst formation rates after vitrification. The vitrification protocol could be simplified and defined without reducing the efficacy by omitting pre-treatment with cytochalasin B and the replacement of albumin with polyvinylpyrrolidone. Vitrification in microdrops resulted in slightly higher survival than using Cryotop; however, the developmental competence of surviving oocytes was similar. Supplementation of the in

vitro maturation medium with the antioxidant and anti-apoptotic agent resveratrol improved the ability of vitrified immature oocytes to develop to the blastocyst stage. However, such effect was not observed on non-vitrified oocytes suggesting that vitrification-related alterations in oocytes were at least partially recovered by resveratrol. We have applied our vitrification protocol on the oocytes of Ban, an indigenous Vietnamese pig breed and achieved survival and post-warming maturation rates similar to those of Landrace oocytes. Currently, research is in progress to clarify vitrification-related cellular damages and recovery mechanisms in oocytes. This work was supported by JST/JICA SATREPS.

APPLICATION OF REPRODUCTIVE METHODS IN FATTY PIGS (S5OC03)

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To manage large groups of sows in common pig production, group-wise reproduction by means of biotechnical methods is an ultimate tool. These methods include in gilts and sows synchronization of estrus, stimulation of follicle development, ovulation induction, fixed-time insemination and synchronization of parturition. The question arises if these methods are also applicable in fatty pigs. So far, only little experiences are available. Group-wise weaning of piglets has been done in Mangalicasows to synchronize onset of estrus. In Mangalica and Iberian gilts, estrus was successful synchronized with feeding of daily 16-20 mg altrenogest (Regumate®) for 15 to 18 days. Follicle development was stimulated with different doses of eCG or PG 600 in Mangalica and Iberian gilts and sows. There, using 1000-1250 IU eCG, the number of follicles could be stimulated only marginally compared to Landrace gilts. Important prerequisites for fixed-time insemination are that all females would have a similar timed LH surge and all follicles would ovulate in a defined time window. Human Chorion Gonadotropin (hCG) or synthetic Gonadotropin Releasing Hormone (GnRH) allow to induce timed ovulation with some preference for GnRH. The induced LH surge parameters do not differ between fatty pigs and modern breeds, and the onset of ovulation within a group of female varies between 32 and 44 h, similarly to Landrace gilts. Because of that, fixed-time insemination can be successfully performed. First insemination should be done at 24-26 h and the second one 36-38 h after ovulation induction with GnRH or hCG. Although, synchronization of parturition in modern pig breeds is a common tool to manage pig production, no results has been published in fatty pigs, yet. Since the management of reproduction of fatty pigs is in some way specially, group-wise reproduction and the application of biotechnical reproductive methods, respectively, will not become the same significance as in modern breeds.

EFFECT OF PROTEIN IN TESTICULAR MORPHOLOGY OF KOLBROEK BOARS (S5OC04)

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Morphometric analysis on the testes of any species or breed is necessary in predicting not only sperm production but also of the storage potentials and fertilizing ability of the male fertility. The objective of this study was to evaluate the effect of protein diet on testicular morphology of Kolbroek boars. A total of 14 Kolbroek boars aged 11 months with an average weight of 98 kg were randomly allocated to three protein diets comprising of 10, 13 and 16%. Diet 1 (10%, n=5); 2 (13%, n=4) and 3 (16%, n=5). Thereafter, two boars were randomly selected from each treatment at the end of the protein digestibility. Selected boars were slaughtered and their reproductive organs were carefully dissected out and separated into different components and measured each per treatment group. The left and right testis were fixed with formaldehyde and later processed for histological assessment. Data on testicular morphology was analyzed by analysis of variance (ANOVA) using the General Linear Model. There was no significant difference on length and weight for Kolbroek boars irrespective of the diet. However, there was a significant difference between boars fed 13 (3.5 mm) & 16 % (5.0mm) protein on right testis width (RTW). There also was a significant different between boars fed different protein diet on left epididymis weight (LEW) 10% (29.2g), 13% (36.1g) and 16% (49.4g) and testicular volume (TV) (557.5, 407.4 and 708.5 cm3) were affected by protein diet levels. Additionally, a relationship existed between the left and right testicular dimensions. There was a highly positive correlation between left testis length (LTL) and right testis length (RTL) (r=0.90). LEW and right epididymis weight (REW) showed also a highly positive correlation (r= 0.69). Negative correlations existed between body weight (BW) and RTL (r= -0.78) also between BW and RTW (r= -0.05). The seminiferous tubules showed active spermatogenesis with different tubules showing different stage

of sperm production. In conclusion, 13% protein diet had a positive influence on kolbroek boars' testicular morphology. The left and right testicle had positive correlation to each other.

Key words: Kolbroek pigs, testicular morphology, histological changes, protein diet

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REPRODUCTIVE CHARACTERIZATION OF A NATIVE PIG BREED (MOO LAT) IN LAOS (S5OC05)

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During the last couple of years pig farming has undergone a big change in Laos due to increasing activity of modern farms. Since modern farms breed modern pigs (in Lao terms exotic pigs), the number of native Moo Lat race has stepwise decreased. However the modern farm's number increase, the traditional pig farming still has a significant reputation which based on Moo Lat breeding and belongs to smallholders. The native breed's reproductive and productive performance is diminished compared to intensive breeds but produce high quality, unique so called „fatty" pork meets high consumer demand. To improve the smallholders breeding performances the reproductive characteristics needed to be clarified. In the present study data of gilts, sows and boars are collected and evaluate.

In the frame of Hungarian-Lao cooperation the morphologic characterization had been done already but the reproductive characterization is still needed. Since the morphology of reproductive organs can affect reproductive performance a study was conducted to obtain information about the number of corpora lutea and size of reproductive tract of Moo Lat pig. The reproductive organs of 34 gilts (6-11 month), 13 sows (> 1 parity) were recovered right after slaughtering to determine the number of ovarian features, the weight and diameter of the ovaries and the length of uteri and oviducts. The mean number of ovulations was 8,8 ± 2,9 and 10,5 ± 4,5 in gilts and sows, respectively. The mean oviduct length was 26,3 ± 1,3 and 33,0 ± 3,1; ovarian weight was 4,3 ± 0,6 and 5,3 ± 0,8. These data were not differing in gilts and sows. Uterine weight was significantly higher in sows (219 ± 19 g; 229 ± 9 cm) compared to the cycling gilts (131 ± 57 g; 76 ± 5 cm).

Presently liquid semen preservation and artificial insemination are used in the so called exotic pig breeding; however it could be

beneficial to use AI in propagation and preservation of indigenous breeds, as well. Different extenders were tested in a pilot study. Semen was collected by gloved hand method, motility and morphology was determined after collection. Only ejaculate with 80% motility and less than 15% abnormal cells were included in the trial. 12 mixed semen samples were diluted 1:5 with three extenders (BTS, Acromax and MRA) and preserved at 17 ˚C for five days. The life/dead cells rate was determined after Giemsa staining. Motility was assessed every day during the preservation period. There was no significant difference in the motility and dead cells rate between the extenders in the storage. However, after day 2 the sperm parameters tended to be better in MRA extender. On day 3 more than 60% motile cells were observed in MRA only, and this declined to 45% on day 5. All of the extender can be used for semen storage for insemination within two days; however MRA could be used in 3-4 days, as well. Undoubtedly further trials are needed to improve the liquid preservation of Moo Lat boar semen.

Only a few native pig breeds exist in different utilization worldwide, for example Iberico in Spain and Portugal, Mangalica in Hungary, Gascon in France, Kolbroek in South Africa and Moo Lat in Lao PDR which still has got a big population in Southeast Asia. Preliminary results above can be used in propagation and preservation of the Lao fatty pig breed which may able to present not only national but also economic value by producing premium pork.

RECENT PROGRESS ON CRYOPRESERVATION AND UTILIZATION OF TESTICULAR TISSUES FOR PIG REPRODUCTION (S5OC06)

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In mammals including pigs, the prevailed type of genetic materials for routine cryopreservation by gene banking is spermatozoa. Banking of other materials such as oocytes or early embryos has been considered challenging. Gonadal tissues, especially testicular tissues have been considered to be very important for this purpose. Some attempts for vitrification and utilization of testicular tissues have been made for pig genetic resources. We have already reported some successful results in this technology. In this meeting, we will discuss the recent progress of cryopreservation and utilization of the testicular tissues for genetic resources. One important approach for inducing spermatogenesis in isolated and vitrified testicular tissues is grafting (xenografting) into immunodeficient animals such as commercially available severe combined immunodeficiency (SCID) mice or nude mice. We have checked the possibility of vitrification of testicular tissue fragments before xenografting, which enables long-term storage of the tissue and the production of sperm whenever the need arises. After grafting of the vitrified/warmed tissues into mice, boar spermatogonia in the seminiferous tubules in the tissues could reach spermatozoa, and live piglets were obtained after oocytes were injected with xenogeneic sperm and transferred to recipients. After growing up to the adulthood, both male and female pigs showed normal reproductive abilities. These observations suggest that testicular tissue cryopreservation is one of possibilities for preservation of genetic resources in pigs

Keywords: testicular tissue, vitrification, xenografting, gene bank

Session 6. Nutrition and new technologies

NUTRITIONAL AND PHYSIOLOGICAL CHARACTERISTICS OF IBERIAN PIGS AS AN EXAMPLE OF FATTY PIG BREED (S6OC01)

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The precise knowledge of nutritional requirements allows the designing of balanced diets to optimize growth, development and body functions, minimize budget costs and reduce the environmental impact of pig production. As a fatty, non-selected, pig-type, the Iberian pig requires less dietary protein than conventional lean pigs during different productive phases, according to its lower muscle mass and protein deposition rates. This has been determined in dose-response experiments covering growing and fattening stages. In parallel to these studies, of mainly applied nature, comparative studies involving conventional pig breeds have been undertaken with the aim of explaining some of the metabolic peculiarities of this native porcine breed. With these purpose we will describe, among other examples, how this breed respond to essential amino acid deficiencies, and the possible consequences on growth, performance and meat quality. This later aspect shows in a way how protein and lipid metabolism can be linked and interrelated at the muscle level. We will deal with amino acid profiles of body protein, and how this approach can help to identify better definition of dietary amino acid profile for a fatty pig, with positive consequences in performance, welfare and environment. Last findings in the framework of the TREASURE project involving nutritional requirements in particular management situations, like immunocastrated pigs, or in productive phases not undertaken before, as lactating sows, will be also covered with the first results available.

Keywords: Iberian pig, protein nutrition, physiology, growth, muscle, fat deposition

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TREASURE). The content of this paper reflects only the author's view and the European Union Agency is not responsible for any use that may be made of the information it contains.

MOLECULAR BIOMARKERS AS PREDICTORS OF SENSORY AND TECHNOLOGICAL PORK QUALITY (S6OC02)

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Sensory and technological qualities of pork result from complex interactions between pig genotype, rearing conditions, and slaughtering and meat processing conditions. Despite improve knowledge on its underlying mechanisms, meat quality (MQ) still exhibits a high variability. Moreover, MQ is assessed by various indicators measured 24h up to few days post-mortem (p.m.) by using costly and/or invasive analyses. Early p.m. predictors of MQ could be used as decision-making tools in slaughterhouses to better allocate carcasses or cuts to the appropriate processes or markets. Recent developments in functional genomics enable high throughput screening of gene expression. Transcriptomics profiles of Longissimus muscle (LM) obtained by specific microarray (15K) were used to identify early p.m. biomarkers of MQ, i.e. genes whose expression level is associated to MQ traits. The experimental design included pigs from contrasted breeds (Basque, French local breed leading to high quality pork and Large White, n=50) produced in different systems, inducing a high and gradual variability in MQ. Numerous associations between LM gene expression level and MQ traits (pH, drip loss, colour, intramuscular fat, shear force, tenderness) were identified. On 40 of these genes, 113 transcript-trait associations were confirmed ($P<0.05$, $|r|\leq0.73$) by qRT-PCR, out of which 60 were validated ($P<0.05$, $|r|\leq0.68$) on complementary experimental data (n=50). Then, 19 of these biomarkers of MQ were externally validated on 100 commercial pigs ($P<0.05$, $|r|\leq0.49$). Thus, biomarkers of MQ were identified and validated, but their predictive value remained improvement before considering the development of control tools. Therefore another approach consisting in identifying biomarkers predicting overall pork quality level was developed. Using MQ data of 100 Basque or Large White pigs described above, scientific and statistical approaches were combined to select indicators and their thresholds to specify pork quality classes differing in sensory and technological dimensions: low (=defective; L), acceptable (A) and extra (E) quality. Gene expressions were used as predictive

variables in a generalized linear model to discriminate quality classes. The best model included expression levels of 12 genes (24% error rate after cross validation). External validation will be undertaken on LM samples from various local breeds collected within the Treasure1 project.

Keywords: meat quality, transcriptomics, biomarkers, pigs

HEADSPACE-GAS CHROMATOGRAPHY-ION MOBILITY SPECTROMETRY TO AVOID LABELLING FRAUD IN IBERIAN HAM SAMPLES (S6OC03)

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A gas chromatography (GC) column coupled to ion mobility spectrometry (IMS) was used for classifying Iberian dry-cured ham depending on the breed cross (pure Iberian breed and crossed with Duroc breed) and depending on the pig finishing feeding regime, acorn-fed (free grazing of acorns and grass) or feed-fed. For this purpose, a sampling procedure using minced slices of cured ham and a non-invasive sampling method were tested. In the second sampling procedure, injectable needles were punctured in cured hams to impregnate these with fat. Due to the two-dimensional nature of GC-IMS measurements chemometric processing was required. Data from samples of ham slices was treated using two different chemometric approaches for differentiation of the feeding regime: A first approach based on the processing of the complete spectral fingerprint, providing a classification rate of 90% and a second approach consisting on the selection of 16 markers that appeared throughout the spectra resulted in a 100% classification rate. Based on these results, the second approach resulted in better classification and it was selected for the next data treatments in this project. When a non-invasive sampling procedure was used, two models were obtained, one for pig finishing feeding regime providing a validated classification rate of 91.7%, and other model for breed differentiation, providing a validated classification rate of 100% (all samples were correctly classified). In this case, 29 of the 85 markers used for the chemometric model construction were identified measuring individual standards (mainly alcohols, aldehydes and ketones) from compounds found in cured Iberian ham. So, the combination of GC-IMS and injectable needles is a feasible method to avoid labeling fraud.

Keywords: Iberian ham classification, Commercial fraud, Ion Mobility Spectrometry, Gas Chromatography and Chemometrics, feeding regime, breed

FOOD AUTHENTICITY - SPECIES IDENTIFICATION IN AN OFFICIAL FOOD CONTROL LABORATORY (S6OC04)

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According to national and international food regulations, food has to be safe and authentic. Recent food scandals demonstrate that food adulteration is a problem all over the world. Food adulteration covers a variety of aspects, including substitution of food components, dilution, the use of non-authorized food processing steps and the declaration of an incorrect geographical origin. The fight against food fraud is an EU priority aimed at keeping the highest food safety standards. Meat products are particular prone to be adulterated by replacing high-value meat from more expensive animal species by cheaper ones (Ballin, Vogensen, & Karlsson, 2009). Therefore, food fraud is a considerable problem for consumers that attempt to avoid the consumption of certain meat species or breeds due to health, religious or ethical reasons. Products made from old, autochthonous and rustic breeds sources became more popular in recent years, not only for their high sensorial quality, but also for being considered as an important part of national and regional heritage. Developing and validating methods to reliably identifying such breeds and to determine the geographical origin is an important component in the fight against deceptive activities.

Keywords: Authenticity, food fraud, DNA barcoding, meat species identification

CHARACTERISTICS OF THE CARCASS AND MEAT OF THE CHATO MURCIANO PIG FED WITH CAROB BEAN (*CERATONIA SILIQUA)* (S6P01)

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The autochthonous Chato Murciano pig breed from the Region of Murcia (Spain) have a big meat quality. This has been demostrated for the works done and the differents tasting done in the last year during the various culinary workshops, using the meat from this pig breed. The aim of this work is to study the carcass and meat quality of the Chato Murciano pig, bred in and intensive sistema and fed witth carob (typical product from Murcia). In order to were utilized forty castrated males of Chato Murciano pig, fed with a commercial fodder including a 15% of carob bean. The animals were sacrificed in an authorised slaughterhouse with an average live weight of 140 kg and with age of 11 months. The hot weights of the carcass were taking and were measured six morphometric parameters on the hanging right half of the carcass. Besides, the carcass was quartered using the traditional Murcian methods. Some of the mean results obtained are (averages): hot carcass weigth of 121.9 ± 17.7 kgr, carcass length of 87.8 ± 4.3 cm, máximum perimeter of the ham of 79.4 ± 4.2 cm, and ham length of 39,5 ± 2.4 cm. The average of the most valuables meat cuts are: loin of 5.34 ± 1.2 kg (a 4.24% with respect to the carcass weight). The weight shoulders were 15, 04 ± 3.2 kg (a 12.72% with respect to the carcass weight), and the ham with bone had a weight of 28.1 ± 4.1 kg (a 23.03% with respect to the carcass weight).

The results obtained show that the 15% carob bean used produce carcass with morphometric parameters more higher to the animals fed with a commercial fodder, especially in carcass length, máximum perimeter of the ham and ham with bone length. But, the loins, shoulders and hams, had a smaller percentage with respect to the carcass weigth. Therefor, is necessary to continue the study for determine the more adecuated carob bean percentage, this with the

incentive to use in the animal food a traditional product from the Region of Murcia.

Keywords: Chato Murciano, carcass quality, meat quality, carob bean

COMPARATIVE STUDY OF THE CARCASS AND MEAT QUALITY OF THE CHATO MURCIANO PIG. FED WITH COMMERCIAL FODDER VERSUS 15% CAROB BEAN *(CERATONIA SILIQUA)* (S6P02)

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The autochthonous Chato Murciano pig breef from the Region of Murcia (Spain) have at present a increase tasting of the fresh meat and the transformed meat products. Different works indicate that the carcass and meat quality change with the fat and protein contents from the diet, increasing the dorsal and intramuscular fat as the fat in the fodder provide in the nutrition is increasing.

The aim of this work is to compare the carcass and meat quality of the Chato Murciano pig bred in and intensive sistema and fed with two differents ways, with the commercial fodder (group I) and with 15% carob bean (group II). In order to were utilized forty castrated males of Chato Murciano pig, fed with a commercial fodder including a 15% of carob bean (*Ceratonia siliqua*) and forty castrated males fed with a commercial fodder. The animals were sacrificed in an authorised slaughterhouse with an average live weight of 140 kg and with age of 11 months. The parameters analyzed were: dorsal fat thickness measured in four places, pH and color in the longisimus muscle (45 minutes and 24 hours postmortem), drip losses and cooking loss. Some of the mean results obtained are (averages): the dorsal fat thickness were higher for the group II ((64.83 ± 8.07 mm for the measure at the first rib, and 48.25 ± 7.45 mm for the group I). The pH was superior in the group I (6.44 y 5.70 in front of a 6.08 y 5.54 for the group II). The L*, a* and b* indexes were higher for the animals fed with carob bean. But, the cooking loss were higher in the group I (21,79% ± 2, and 19.3% ± 3.24 fot the group II). The results obtained show that the food with a 15% carob bean have influence in the carcarss quality parameters, especially in the fat amount. Besides, the cooking loss are better for the carob group. However, is necessary to continue study the different percentages of carob bean to determine the ideal percentage.

Keywords: Chato Murciano, pH, meat quality, carob bean

MALHADO DE ALCOBAÇA PIG BREED: METABOLIC CHARACTERISTICS, GROWTH PERFORMANCE AND CARCASS TRAITS (S6P03)

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An experiment was conducted with *Malhado de Alcobaça* pig breed aiming to evaluate the effect of the partial replacement of soybean meal by pea (10.6 %, *Pea sativum L*) or white lupin (8.8%, *Lupinus albus L*.) on metabolic characteristics, growth performances, carcass traits and to contribute to breed characterization. Experimental diets were formulated to be isoenergetic, isoproteic and were supplied *ad libitum*. Twelve males were allocated in individual metabolism crates for control of feed intake and separated sampling of feces and urine, following a Latin square experimental design, comprising three adaptation periods followed by the response phase to the diets under study. Apparent digestibility and balance of dietary nitrogen, dry matter and energy, as well as the fractioning of N excretions were evaluated. Pigs were weighed each week. At slaughter, information was collected on: carcass weights, yield and dimensions; weight of organs, carcass cuts, and abdominal fat depots; backfat depth; measurements of the *Longissimus. thoracis* (LT); and yield of different ham tissues. The inclusion of the new protein sources, pea and lupine, in the diets didn't significantly affect the different parameters evaluated. Regarding growth performances (from 43.7 to 87.7 kg LW) average daily gains of 1.26 kg and feed conversion ratios of 2.15 were observed. Dry matter, nitrogen and energy digestibility were 87%, 85% and 86%, respectively. Although with similar digestibility, nitrogen and energy balances were 54% and 85% of the intake, respectively. At slaughter, the animals evaluated presented weight between 76.5 and 98.0 kg, corresponding to carcasses in the range of 55.0 and 74.4 kg, with an average dressing percentage of 76.8%. Abdominal fat showed an average content of 1452g (2.2% CCW) of which omental fat (106.7g), mesenteric fat (396.7g) and kidney fat (949.2g). Measurements at point P2 revealed an average depth of 52.1 mm for the LT muscle and 21.5 mm for the backfat. Yield of ham tissues was 57.7% of lean meat, 9.6% of bone and 18.5% of fat. Overall, new proteins sources tested had a reduced impact

on metabolic characteristics and growth performance of Malhado de Alcobaça pigs which produced meat of normal quality.

EFFECT OF THE ORAL ADMINISTRATION OF PROBIOTICS AND VITAMIN D SUPPLEMENTS IN IBERIAN PIGS (S6P04)

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Until 2006, the use of antibiotics as growth promoters was a very common practice in livestock. The widespread increase in the use of antibiotics, led to the development of multi-resistant pathogenic bacterial strains whose impact on human health was unknown. This entailed the gradual withdrawal of antibiotics as growth promoters in livestock. Its use was finally banned in the European Union from January 2006. This prohibition has favoured an intensive research focused on the development of alternative strategies to maintain animal health and performance. The aim of our study is to evaluate the effectiveness of a probiotic product and its possible synergy with a supplement rich in vitamin D_3 in the improvement of health and production parameters in Iberian piglets. The experience is being developed in an extensive Iberian pig farm located in Salorino, Cáceres (Southwestern Spain). The study included 15 reproductive sows (100% Iberian breed) inseminated by natural mating with 100% Iberian breed boars. There have been 3 groups:

Control group (n = 5 sows + litter): Sows fed throughout lactation with a standard lactation feed and piglets from the 2nd week with a pre-starter feed, without any supplementation.

Probiotic group (n = 5 sows + litter): Same type of feeding as the control group, but supplemented with 2 g of probiotic per kg of feed.

Probiotic + Vit D3 group (n = 5 sows + litter): Same type of feeding as the Probiotic group + 60 grs per week of Vit D_3 for both sow and piglets.

Piglets had been sampled at 3 days of birth, at 21 days and at weaning (45 days). Each piglet was individually weighed, two rectal swabs were collected from two animals per litter and on days 21 and 45 blood samples were taken from these same animals after having been vaccinated against porcine circovirus type 2 (PCV -2) on day 21. At present, the productive and health indexes between the different groups, the proportion of aerobic bacteria and lactic bacteria between each group and the possible differences in the production of antibodies after the vaccination are being analysed.

Keywords: antimicrobial resistance, probiotics, vitamine D_3.

PRESERVATION OF SLICED IBERIAN DRY-CURED SHOULDER USING HIGH HYDROSTATIC PRESSURE AND AN ACTIVE PACKAGING OF OLIVE LEAF EXTRACT (S6P05)

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High pressure processing (HPP) is a non-thermal technology applied to sliced dry-cured ham to reduce microbiological risk after slicing process. However, this process could favour increase the sensitivity of sliced ham to the development of oxidative processes after the treatment or during the subsequent storage. The development of an active packaging (AP) with antioxidant and antimicrobial properties, such as by the application of the olive leaf extract, could maintain the excellent quality of sliced Iberian dry-cured ham during processing and storage. The combination of AP with the application of high pressure processing (HPP), could improve the benefits of application of both treatments technology. The main objective of this study was to evaluate the effect of an AP and/or HPP to maintain the quality of sliced Iberian dry-cured shoulder. Four different batches were tested: control (vacuum packaged sliced dry-cured shoulder), vacuum packed sliced dry-cured shoulder subjected to HPP (600 MPa for 7 min), AP prepared with olive leaf extract, and another batch combing the last two (HPP + AP). Packages were refrigerated for 150 days, and samplings were performed each 50 days. Lipid and protein oxidation during storage was evaluated.

Results indicated that there were no differences among the four batches due to the effect of HPP and/or AP over 150 days of refrigeration. AP used was not effective to reduce the development of lipid or protein oxidation. Therefore, the antioxidant activity of the olive leaf extracts tested “in vitro” was not effective to preserve sliced shoulder. Furthermore, HPP did not induce either lipid or protein oxidation changes.

Key words: Active packaging, HPP, olive leaf extract, Iberian dry-cured shoulder

Session 7. Impact of policy on premium pork production and Future tasks in fatty pig applied science

IBERIAN PIG NICHE MARKET (S70C01)

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The Iberian pig constitutes a singular breed, strongly adapted to ecological conditions of the "Dehesa" ecosystem, located in the south west of the Iberian Peninsula. This breed includes a number of strains, all of them showing low prolificity and growth rates and a very early maturing fat deposition, thus with a low performance in comparison to modern pig strains. Iberian pig raised under traditional production systems produce meat of an excellent quality, which is particularly suitable for dry cured meat production, as it has a high percentage of red muscle fibres, high marbling score and a unique fatty acid profile. There are four Protected Designations of Origin (Dehesa de Extremadura, Guijuelo, Pedroches and Jabugo) which are devoted to the production of top quality meat products from pigs raised in extensive system and elaborated under strict norms of industrial manufacture. Productive systems based on autochthonous breed and traditional extensive systems usually have problems in the commercialization of the products. Atomized production and lack of uniformity makes difficult to reach big consumer markets. In the case of Iberian pig, main limiting factor is the existence of Dehesa ecosystem able to support swine production. However, the high acceptance of these products in the Spanish market has allowed the flourishing of an alternative (and parallel) production system still based on this breed, but fed with mixed diets, and in some cases produced indoors and crosses with Duroc sires. Quality of meat products is still high, thus producing an intermediate quality level of products, between top quality from pure Iberian pigs raised under Dehesa system, and those obtained from modern pig genotypes. At the moment, over 2 million Iberian pigs are slaughtered in Spain each year, about 15% of which are fattened under free-range conditions. The remaining 85% of the Iberian pig production are reared in confinement and fed on mixed diets. Regulatory norm compulsory establish that the use of pure Iberian sows if the meat products are commercialized as Ibérico, thus linking Iberian pig production to specific geographical areas with a high density of this breed. Interesting to note

that more than 90% of these pigs are produced in locations near the original area of Iberian pig production, a place where swine production has limited feasibility unless it is linked to quality meat production. Iberian pig emphasizes the importance of niche market production in rural regions, and open up a debate on where to place the limit of niche market and differentiated production system.

CAN SCIENCE SAVE FATTY PIG? (S7OC03)

E. Dieguez Garbayo

Presidenta. FESERAPAE

The autochthonous swine breeds have been in danger of extinction since the middle of the 20th century. This has been the main reason for the creation of the FEDERATION OF EXTENSIVE AUTOCONAL SWINE BREEDS, FESERPAE. The introduction of IN-DOOR (intensive) systems of pig production with improved breeds and high yields has led to the loss of an important genetic heritage and the abandonment of the conservation of the natural ecosystems previously maintained thanks to OUT DOOR (extensive) swine production.

Quality and uniqueness make these productions an option of necessary maintenance.

Science can bring competitive advantages to these autochthonous breeds through genetic and genomic selection that improves their productive factors and enhances the quality of their derived products. The rustic character of these races is not a reason for abandoning a serious and transcendental investigation for their survival.

The other order of vital importance is to show the healthy nature of the consumption of its derived products and the study of measures that guarantee the animal welfare and biosafety of its OUT DOOR (extensive) farms.

Key words: genetic, genomic, health, outdoor

FUTURE TASKS IN FATTY PIG APPLIED SCIENCE (S7OC05)

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Local, autochthonous fatty pigs are robust, rustic breeds well adapted to their environment that make an advantageous use of local natural resources. However, they became endangered due to lower productivity some decades ago. Fortunately, the current interest of worldwide consumers for the high-quality of local fatty-pig products is favouring the recovery of some of their populations, although some of their less productive strains are still highly endangered. Paradoxically, this increasing demand for fatty-pig products is transforming the traditional extensive management of these breeds into more intensive production schemes, thus decreasing the sustainability and resilience of their production systems. Indeed, this intensification ignores the physiology of fatty breeds and their trend for adiposity and obesity, therefore rendering conventional extensive systems inadequate for the sustainable use of these breeds. In contrast, traditional extensive systems not only assure the sustainable use and welfare of the pigs and the quality and health benefits of their products, but also contribute to the sustainable use and preservation of the large forest and rangeland areas used for rearing these breeds, therefore promoting environmental diversity. Thus, the preservation of fatty-pigs breeds in their traditional local ecosystems contributes to economical and societal sustainability of rural areas by increasing their profitability and business and employment opportunities, which mitigates the exodus to industrialized areas. Nevertheless, fatty-pig production faces important technical challenges that remain unsolved, especially those derived from their peculiar energetic metabolism, the prolonged growing and finishing phases and the low prolificacy. Consequently, the fatty-pig producers need to optimize their production procedures in a sustainable way to adapt to the current variable market conditions to meet the increasing demand for high-quality meat products.

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