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BOOK OF ABSTRACTS



# 9th International Symposium on Mediterranean Pig

## Book of Abstracts

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## FOREWORD

Welcome to the 9th Mediterranean Pig International Symposium. It is our pleasure to welcome all colleagues and participants in Portalegre – Portugal. Twenty-seven years after the first symposium in Ajaccio-Corse we hope to have a fruitful and challenging Symposium where opening discussion and innovation approaches, concerning pig production in sylvo-pastural/open systems, lead to improve and update our present understanding.

Mediterranean pig production has developed in dissimilar ways across countries influenced by Mediterranean weather. Thus, nowadays we can find different structures, different systems and different management programs to raise autochthonous pig breeds. A clear proof is the different development of pork processing and marketing approaches among regions.

We can characterize these open systems as based on local breeds that use, in a sustainable way, natural feedstuffs resources and produce raw material to process by using ancestral knowledge on particular meat products like hams and sausages. These agro-sylvo-pastural/open systems and typical high grade products are in our time a good source of income to peripheral regions of Europe and add to fixe populations, by means of direct sale and specific touristic routes.

Along almost thirty years related research has tried to incorporate into the row interdisciplinary approaches that helped to translate scientific knowledge and new adaptive technologies and management solutions, as well as new marketing strategies, facing innovation as a water- pipe from science to practice and vice versa.

This symposium enlarged the number of participating countries/teams. All of us hope it can become a milestone for new approaches to build progress and create advances in new knowledge products and increase income, mainly to marginal areas of Southern Europe.

## **SESSION 1**

### **GENETICS**

#### **ORAL COMMUNICATIONS**

## SURVEY OF DEMOGRAPHIC AND PHENOTYPIC DATA OF LOCAL PIG BREEDS OF TREASURE PROJECT

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**Abstract:** Local genetic resources represent an important reservoir of biodiversity in the animal sector. Sustainable use of these resources can be an important source of income for farmers taking advantage of the peculiar characteristics of their products.

The different European local pig breeds have a different level of knowledge of their characteristics both at demographic and phenotypic level. This information, however, is fundamental to the management of the breeds and represent one of the first steps in a project for the enhancement of production. This paper reports the results of a survey on the demographic and phenotypic characterization of the 20 European local pig breeds involved in the TREASURE\* project. The first part of the survey shows, for all populations involved, the available demographic parameters, the structure of the breed (i.e. number of males, females and replacements), the main morphological features, the reproductive information as well as some additional information collected at herd-level (i.e. temperament, holding, mating practices). A second module reports the results related to the origins and development of the breeds, to market characteristics and the presence and distribution of niche products. The survey concludes with a module related to the specific characteristics of each breed and the management of the same in relation to food and the environment. The survey is the starting point of the genetic and productive characterization of the breeds involved that are future actions of the TREASURE project.

**Keywords:** local pig breeds, demography, phenotypic data.

\* 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.

OC - 1438

**SESSION 1**

**GENETICS**

**POSTERS**



## IDENTIFICATION OF POTENTIAL PORCINE COAT COLOUR GENE MARKERS

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**Abstract:** Coat colour gene variants, such as *MC1R* and *KIT* alleles, are successfully used to characterize livestock breeds and populations. Moreover they constitute informative markers to determine genetic origin in traceability analysis. In pigs, several chromosomal regions with effects on coat colour patterns have been reported, however the identification of actual causal mutations is limited to *MC1R* and *KIT* polymorphisms. The aim of the current study was to analyse new positional and functional candidate genes for the previously identified QTLs in F2 pigs of a Black Iberian x Landrace experimental population. The previous QTL scan allowed us to detect the known QTLs on SSC6 (*MC1R* effect) and SSC8 (*KIT* effect), but also other QTLs on SSC1, SSC7, SSC9, SSC12, SSC13 and SSC17, for which polymorphisms in candidate genes have been investigated in the current study. The *SLC24A5*, *DTNBP1*, *KRT23*, *KRT24*, *XPC*, *AGOUTI*, and *ATRN* genes were selected as powerful positional and functional candidates. Genetic variants within these genes were identified from a previous RNA-Seq assay on an experimental F1 (Iberian x Landrace) x Landrace backcross. Polymorphisms for all seven genes were identified, however only the *SLC24A5*, *DTNBP1*, *KRT23*, *AGOUTI* and *ATRN* polymorphisms were validated and appeared segregating (MAF: 0.23, 0.27, 0.16, 0.27 and 0.48, respectively) in the F2 Iberian x Landrace pigs with colour records. The association analysis did not reveal causal effects of the tested variants.

Although the analyzed polymorphisms did not show relevant effects, their usefulness for pig population characterization and traceability analysis should be further investigated.

**Keywords:** coat colour pattern, QTLs, porcine, coat colour genes.

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PO - 1359

## LOCAL PIG BREEDS ARE “LESS DOMESTICATED” THAN COMMERCIAL POPULATIONS: EVIDENCES FROM VARIABILITY IN THE MC1R AND NR6A1 GENES IN ITALIAN AUTOCHTHONOUS BREEDS

Anisa Ribani<sup>1</sup>; Valerio Joe Utzeri<sup>1</sup>; Claudia Geraci<sup>1</sup>; Stefania Dall'olio<sup>1</sup>; Leonardo Nanni Costa<sup>1</sup>;  
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**Abstract:** The domestication process in pigs has fixed different phenotypic and morphological traits in many pig populations as a result of selective breeding towards more productive or differentiated populations from the wild counterparts. Coat colour has been one of the first trait that has been modified in domestic pigs. Several alleles at the *Extension* (*E*) locus, that encodes for the melanocortin 1 receptor (*MC1R*) gene, have been characterized at the molecular level and shown to affect coat colours in pigs:  $E^+$ , the wild type allele;  $E^{D1}$  (Asian originated allele) and  $E^{D2}$  (European originated allele), the black dominant alleles;  $E^P$ , associated with black spotting in a red or white background and determined by a recurrent somatic retro-mutation;  $e$ , the recessive allele determining red coat colour. Another trait that has been changed by the domestication and selection processes towards longer and more productive animals is the number of vertebrae. The pig is one of the few vertebrates that presents variability in vertebral number: wild boars have 19 while commercial pigs usually have 21-23 thoracic and lumbar vertebrae. A missense mutation (p.P192L) in the nuclear receptor subfamily 6, group A, member 1 (*NR6A1*) gene has been already reported to be the causative mutation for an important QTL for this trait. The wild type allele (p.192P) has been shown to be fixed in wild boars, whereas the alternative mutated allele has been reported to be fixed in commercial populations. In this study we investigated 364 pigs from five Italian local breeds (74 Mora Romagnola, 114 Casertana, 26 Apulo-Calabrese, 80 Cinta Senese and 70 Nero Siciliano). All animals were genotyped or sequenced to define the genotype at the *MC1R* and *NR6A1* genes. Results showed that all breeds were not fixed for one specific allele at one or the other gene. At the *MC1R* gene, allele  $E^{D2}$  was observed in Apulo-Calabrese (allele frequency: 0.75), Casertana (0.71), Nero Siciliano (0.57) and Cinta Senese (0.84) in which it was the most frequent. The Asian  $E^{D1}$  allele was identified in Nero Siciliano and Cinta Senese (0.07 and 0.01, respectively). Allele  $e$  was the most frequent in Mora Romagnola pigs (0.82), some of which carried also allele  $E^+$  (0.18). The mutated *NR6A1* allele was prevalent in all five local pig breeds. However, while Cinta Senese and Mora Romagnola breeds showed a complete homozygosity for the mutated allele (as observed in commercial breeds), Apulo-Calabrese and Nero Siciliano showed an unexpected quite high frequency (0.23 and 0.28, respectively) of the wild type allele (p.192P). Observed variability in “domesticated” genes in local breeds might be derived by a combination of different events: occasional (due to the extensive production systems in which these populations are usually raised) or deliberate recurrent crossbreeding with wild boars, crossbreeding with other pig breeds and relaxed directional selection towards domesticated traits, i.e. coat colour and number of vertebrae.

**Keywords:** coat colour, vertebrae, SNP, domestication.

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## INVESTIGATION OF GENETIC MARKERS FOR RESISTANCE TO INFECTIOUS DISEASES IN DIFFERENT PIG BREEDS: ANTAGONISM WITH PRODUCTION AND PERFORMANCE TRAITS?

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**Abstract:** Infectious diseases have devastating economic impacts on the pig breeding industry worldwide. A few genetic markers associated with disease resistance have been recently identified and used in Marker Assisted Selection (MAS) in a few pig populations as part of disease control programs. Neonatal Diarrhea (ND), Post-weaning Diarrhea (PWD) caused by enterotoxigenic *Escherichia coli* and Porcine Reproductive and Respiratory Syndrome caused by PRRS virus (PRRSV) are diseases with high priority for the pig industry. Since interactions or antagonism between growth and disease resistance traits could exist, we investigated the association between disease resistance markers already reported by other studies in a few genes (fucosyltransferase 1, *FUT1* associated with resistance to PWD; mucin 4, *MUC4* associated with resistance to ND; and guanylate binding protein 5, *GBP5*, associated with resistance to PRRS) with performance, meat production and carcass traits (average daily gain, ADG; back fat thickness, BFT; lean meat cuts, LC; feed gain ratio, FGR; ham weight, HW) in a total of 581 performance tested Italian Large White pigs. In addition, we evaluated allele frequencies of these polymorphisms in a total of 134 pigs from five local breeds (Apulo-Calabrese, n. 26; Casertana, n. 28; Cinta Senese, n. 29; Mora Romagnola, n. 28; and Nero Siciliano, n. 23). The frequencies of *FUT1* and *GBP5* resistance-associated alleles were low in the Italian Large breed (0.12 and 0.08, respectively). In the same breed, allele frequencies at the *MUC4* polymorphic site were close to 0.5. Frequency of the resistance-associated alleles for the three polymorphisms was usually higher in all local pig breeds, supporting a potential adaptation or natural selection to disease resistance in these populations. Association analyses with production traits carried out in the performance tested Italian Large White pigs showed that all investigated markers were significantly associated with ADG. *FUT1* was also associated with BFT. Pigs with the resistant genotype of *FUT1* had higher ADG while pigs with the resistant genotypes at *MUC4* and *GBP5* showed lower ADG values.

Our results indicate that before implementing MAS programs with markers associated with disease resistance, it is important to evaluate potential pleiotropic or antagonistic effects on other traits.

**Keywords:** disease resistance, production trait, association study, candidate gene.

**Acknowledgements:** This work has received funding from the Italian Ministry of Agriculture, Food and Forestry (MiPAAF) under the project INNOVAGEN and 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.

## GENOME WIDE ASSOCIATION STUDY IN CASERTANA PIGS IDENTIFIES GENOMIC REGIONS AFFECTING THE HAIRLESS PHENOTYPE

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**Abstract:** Casertana is an autochthonous pig breed mainly raised in the Central-South of Italy. This local breed is considered the descendant of the influential Neapolitan breed of the late 18th and 19th centuries. Casertana pigs are characterized by a black or slate-grey coat colour, wrinkled skin, forward ears, two goatlike wattles (not always present) and a typical, almost complete, hairless phenotype. This later characteristic is also reported in one of its local names, i.e. *Pelatella* (that means plucked or bald). Despite hairless is the most important breed-specific phenotype of Casertana pigs, variability for this trait is present in the animals of the breed population, ranging from complete or almost complete absence of hairs (hairless) to presence of more abundant hairs. With the aim to clarify the genetic basis of the hairless phenotype, we carried out a genome wide association study (GWAS) in the Casertana breed by comparing pigs completely or almost completely hairless (n. 81) versus pigs having hairs (n. 15). All pigs were genotyped with the Illumina PorcineSNP60 BeadChip. Genotyping data were processed with PLINK software and 47018 single nucleotide polymorphisms (SNPs) were used to carry out an association analysis with GEMMA software. Results of the GWAS showed a few regions with highly significant SNPs on porcine chromosome 4 (SSC4), SSC7 and SSC15, suggesting that the hairless phenotype might not be determined or influenced by simple Mendelian inheritance. These genomic regions including significant SNPs contain genes already reported to affect alopecia or hair follicle development in humans and other species. Our study contributed to clarify the biological mechanisms affecting the hairless phenotype in pigs.

**Keywords:** GWAS; hairless; SNP; local pig breed.

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**PO - 1421**

## ANALYSIS OF RUNS OF HOMOZYGOSITY IN LOCAL AND COMMERCIAL ITALIAN PIG BREEDS

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**Abstract:** Runs of homozygosity (ROH) are defined as continuous and uninterrupted chromosome regions in which all loci are homozygous in an individual, even if in the population these loci are not fixed for any allele. ROH are single nucleotide polymorphism (SNP)-derived metrics of autozygosity and provide a DNA based measure of the inbreeding level, as the two homozygous long DNA stretches are considered identical by descent (IBD). The individual inbreeding coefficient estimated using ROH information ( $F_{ROH}$ ) is the proportion of the individual genome covered by ROH. In this work, to obtain ROH data, we genotyped with the Illumina PorcineSNP60 BeadChip pigs from seven different breeds: three commercial breeds (Italian Large White, n. 1968; Italian Duroc, n. 432; Italian Landrace, n. 46), under the selection program of the National Pig Breeders Association (ANAS) and four local breeds (Nero Siciliano, 48; Casertana, n. 96; Apulo-Calabrese, n. 92; Cinta Senese, n. 38) under the national conservation program of ANAS. ROH were identified using PLINK software after filtering the dataset (SNPs with MAF > 0.01, call rate > 90%, HWE > 0.0001 were retained) and after applying the following criteria: only 1 missing SNP and 1 heterozygous SNP in a window of at least 50 SNPs were allowed; the maximum gap between consecutive homozygous SNPs was set to 1000 kb. Results reported values of mean  $F_{ROH}$  within breed that ranged from 0.051 in Nero Siciliano (with the lowest mean number of ROH events per animal: 20.9) to 0.163 in Apulo-Calabrese, showing also the largest mean length per ROH (10,620 kb) and the highest proportion of ROH, among all ROH identified, with length > 8 Mbp (38%), suggesting a recent inbreeding in this population. The other two local breeds had mean  $F_{ROH}$  of 0.103 (Cinta Senese) and 0.138 (Casertana) with a quite high proportion of ROH >8 Mbp (17% and 24%, respectively). Commercial pig breeds had mean  $F_{ROH}$  values equal to 0.064 in Italian Large White (with the lowest mean length per ROH: 4248 kb), 0.083 in Italian Landrace and 0.124 in Italian Duroc that showed also the largest mean number of ROH events per animal (57.69) but with the second lowest mean length per ROH (5293 kb), indicating an ancient inbreeding level. These results will be important to define conservation and breeding strategies in both local and commercial pig breeds raised in Italy.

**Keywords:** inbreeding; autozygosity; SNP; biodiversity.

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## **SESSION 2**

### **PRODUCTION SYSTEMS MANAGEMENT, NATURAL RESOURCES AND SUSTAINABILITY**

#### **ORAL COMMUNICATIONS**

## LIFE CYCLE ASSESSMENT OF PIG PRODUCTION SYSTEMS OF THE NOIR DE BIGORRE PORK CHAIN

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**Abstract:** Outdoor pig production systems relying on local pig breeds may cope with environmental and socio-economic challenges of animal production. They produce high quality products with added economic value and mainly rely on local feed resources. Within the European TREASURE\* project, we aimed at evaluating the sustainability of these systems. We conducted the Life Cycle Assessment (LCA) of the Noir de Bigorre (NDB) pig production systems located in South West of France.

The environmental impacts were calculated at farm gate and expressed per kg live pig and per ha land use. From surveys on 25 farms of the NDB pork chain and data collected by the chain, we estimated the flows and average live weights of animals produced as well as the quantities of feeds distributed to the animals. Formulas of the complete feeds were collected from manufacturers. Feed ingredients impacts came from the ECOALIM dataset of the AGRIBALYSE® database.

Climate Change (CC), Acidification (AC), Eutrophication (EU), Cumulative Energy Demand and Land Occupation impacts were in the range of the impacts of outdoor systems previously studied.

CC impact per kg live pig was higher than in intensive systems due to the higher amount of feed needed to reach the slaughter weight. AC and EU impacts per ha of land were relatively low.

NDB pig farming systems exhibit LCA impacts typical of pig extensive and outdoor systems. Further studies within the European TREASURE project will also give insights on the economic and societal dimensions of sustainability of these systems.

**Keywords:** Gascon breed, Life Cycle Assessment, Sustainability.

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OC - 1369

## **GROWTH, CARCASS AND MEAT QUALITY OF GASCON PIGS PRODUCED ACCORDING TO THE NOIR DE BIGORRE PDO SPECIFICATIONS: VARIABILITY AND INFLUENCE OF LOCAL FEEDING RESOURCES ON PHENOTYPIC PIGS\***

Benedicte Lebret<sup>1</sup>; Herveline Lenoir<sup>2</sup>; Alexandre Fonseca<sup>3</sup>; Justine Faure<sup>1</sup>; Marie-José Mercat<sup>2</sup>

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**Abstract:** The Noir de Bigorre (NB) pork chain (pure Gascon breed) recently obtained the national “AOC” label required for further Protected Designation of Origin (PDO) registration, for both fresh meat and dry-cured hams. Pigs produced in extensive conditions (pasture, 20 pigs/ha) consume large quantities of grass and, depending on the season, acorns and chestnuts. Variations in feeding resources and climatic conditions along the fattening period can modulate animal growth, muscle and fat tissue properties, and therefore the intrinsic characteristics of meat and processed products. Within the European TREASURE\* project, we aimed at determining the average value and variability of various phenotypic traits of animals, carcasses and pork products from NB chain according to the pig’s finishing season (winter/spring/autumn). First results obtained on 25 pigs slaughtered at end of winter (168±17 kg live weight, 414±9 days of age) showed an average growth rate of 428±60 g/d during extensive rearing (64 to 168 kg live weight), and ZP-backfat and muscle depths of 45±6 and 67±6 mm, respectively. The few skin scratches and low plasma creatine kinase activity at slaughter indicate satisfactory conditions during pre-slaughter handling of pigs. Longissimus muscle exhibited 2.50±0.55% intramuscular fat, 5.56±0.07 ultimate pH, and 1.52±0.60% drip loss. Color parameters indicated low lightness and high redness of both loin and ham muscles.

Further results on growth, carcass, meat traits and quality of dry cured-hams according to pigs’ finishing season will be useful to actors of the local NB chain to adapt pig management towards continued improvement of sensory quality and differentiation of pork products within the PDO specifications.

**Keywords:** Noir de Bigorre chain, Gascon breed, local resources, pork quality.

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**OC - 1371**



## EFFECT OF PRODUCTION SYSTEM (ORGANIC VS. CONVENTIONAL) AND ROUGHAGE SUPPLEMENTATION IN DIET ON PERFORMANCE OF GROWING-FINISHING KRŠKOPOLJE PIGS

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**Abstract:** Performance of Krškopolje pigs in conventional and organic production system was investigated in project TREASURE\*. Pigs (36 castrates) were assigned within litter to three treatment groups (TG): organic (ECO) with lucerne hay supplementation, conventional (CON) and conventional with pelleted lucerne supplementation (CON+L). Pigs in CON and CON+L were housed indoors (2 pens per TG; 6 pigs per pen) with partially slatted floors (7.5 m<sup>2</sup>), whereas ECO were housed in pen (16 m<sup>2</sup>) with free access to outdoor area. Prior to experiment (starting at the average age of 155 days and body weight-BW 69.4±11.8 kg, 72.3±12.5 kg, 66.4±8.9 kg in CON, CON+L, ECO, respectively), pigs were fed commercial diets for organic or conventional production adapted to the stage of growth, whereas for the experiment two barley based diets were composed; ECO (n=12) received organic feed mixture (12.4 MJ ME, 12.9% CP, 0.7 % Lys), while CON (n=12) and CON+L (n=12) were fed a conventional diet (13.2 MJ ME, 13.6% CP, 1.2 % Lys). Feeding was planned to allow pigs to fully exhibit their growth potential, but to limit excessive fat deposition in the last phase of fattening. Thus, all pigs were initially (before experiment) fed on *ad libitum* basis while during experiment daily feed distribution for ECO and CON was limited to 3.5 kg (~45 MJ ME per pig). Additional 10 % restriction was applied to CON+L. The achieved daily feed distribution in the experiment for CON, CON+L and ECO was in average 3.43, 3.06 and 3.37 kg/day, respectively. ECO and CON+L pigs were supplemented with lucerne hay (ECO) or pellets (CON+L) on *ad libitum* basis. BW after 73 days was statistically not different between TG (120.4±15.8 kg vs. 117.8±14.8 kg vs. 124.3±12.2 kg in CON, CON+L, ECO, respectively). Feed restriction in CON+L resulted in 11% lower average daily gain compared with CON (623 vs. 700 g/day, P=0.148), denoting that CON+L pigs did not compensate restricted feed allowance by consuming lucerne pellets. In contrast, ECO pigs had 13% higher daily gain than CON (792 vs. 700 g/day, P= 0.097), and a rough estimation (based on growth data) is that ECO pigs retained additional 6.0 MJ ME daily either with lucerne hay (6.9 MJ ME/kg, 1.2% Lys) and/or due to a lesser feed dissipation in ECO group (observation). Backfat thickness gain measured with ultrasound at the level of the last rib was 0.28 vs. 0.32 and 0.36 mm/day for CON+L, CON and ECO, respectively (P=0.083). Feed conversion ratio was comparable in CON and CON+L (4.90 vs. 4.91 kg feed/kg gain).

**Keywords:** Krškopolje pigs, growth rate, feed intake, backfat.

\* This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 634476 (Project acronym: TREASURE).

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## GROWTH PERFORMANCE ON BÍSARO PIGS: HOOP BARN MODEL VS CONFINEMENT

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**Abstract:** The goal of this study, made within Treasure\* project, was to evaluate the growth of growing/finishing pigs housed in a hoop barn system, in comparison with traditional confinement. Twenty Bísaro breed pigs, with 98,6±5,71 days' old, and 25,4±4,87 kg of BW, were equally distributed in two groups: Gr1 – hoop barn (2,4 m<sup>2</sup>/pig) with outdoor access (200 m<sup>2</sup>/pig); Gr2 - traditional confinement with bedding (1,8 m<sup>2</sup>/pig). The diet was equal for both groups. During the growing phase (98 days' period) and until 80 kg BW, the animals were subjected to a concentrate diet. Then, for 70 days and until slaughter (110-120 kg BW and finishing phase), cornflour diet was also available. The feed intake per group was registered daily and growth performances were statistically analysed. The daily gain (ADG) during growing phase was 0,546±0,10 kg (Gr1) and 0,563±0,05 kg (Gr2) with no significant differences (P>0,05), but with higher variability in hoop barn group (CV of 18,1% vs 8,8% confinement). In the finishing phase, the ADG was 0,535±0,09 kg (Gr1) and 0,505±0,07 kg (Gr2) (P>0,05). The food conversion rate (FCR) in both growing and finishing phases were 3,11 kg/kg (Gr1) and 3,12 kg/kg (Gr2) and 3,44 (Gr1) and 3,53 (Gr2), respectively. There was no difference in the ADG between genders in both phases (P>0,05). Despite the differences, ADG and FCR were identical in both production systems. To the consumer's eye, the gains associated with the hoop barn system, such as the use of uncultivated land, pig welfare and product image, are attractive and therefore, this will further be reflected in the market.

**Keywords:** Bísaro breed; daily gain; food conversion ratio; production system.

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OC - 1414

## **SESSION 2**

### **PRODUCTION SYSTEMS MANAGEMENT, NATURAL RESOURCES AND SUSTAINABILITY**

## **POSTERS**

## USE OF RICE HUSK IN IBERIAN PIGS DURING PREMONTANERA PERIOD FOR WELFARE DIETS.

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<sup>1</sup>CICYTEX

**Abstract:** Rice husk is a byproduct of rice crop and accounts for around 20% of whole grain weight. Rice crop is very important in Extremadura. Several uses have been described for rice husk but, nowadays, it can be considered practically a crop residue because of its underutilization. The husk is the outermost layer of the rice grain and is separated from the rice grains during the milling process. The major limitation to its use as animal feed is the high silica content, apart from low protein and high lignocellulose contents. On the other hand, animals are underfed during the *premontanera* period in extensive Iberian pig production systems. The use of byproducts rich in fiber as feed supplements could help increasing animal welfare and reducing body weight variability by increasing satiety. The use of local agro-by-products for feeding local pig breeds will be evaluated within the TREASURE\* H2020 project. Thus, different diets with increasing levels of fiber from rice husk will be used for feeding Iberian pigs during the *premontanera* period in order to study their effect on animal welfare and body weight variability. Rice husk will be supplied in pellet form. In order to evaluate the potential production of rice husk, different field crop trials were carried out during four years. The ratio between the weight of rice husk and whole rice grain ranged from 0.15 to 0.22 and was influenced by variety and year.

**Keywords:** Iberian pig, Animal welfare, Rice husk, Byproducts.

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PO - 1347

## GROWTH OF KRŠKOPOLJE PIGLETS DURING LACTATION AND THE FIRST REARING PERIOD

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**Abstract:** The only Slovenian autochthonous pig breed (Krškopolje) is reared in very diverse conditions. Many small-scale breeders are rearing these pigs in extensive conditions, often using a combination of indoor and outdoor system, while some breeders are dealing with a more intensive production. Growth rates, reflecting different feeding regimes, are consequently very diverse. Due to the fact that literature data on this pig breed is scarce, growth potential in different phases of growth was assessed within the TREASURE\* project. Growth of the piglets in the pre-weaning period (n=156; born within 2 weeks period) was recorded on the farms of their origin (7 organic and 11 conventional), whereas growth in the post-weaning period was recorded on a subsample of piglets transferred to the experimental farm (n=42; 3 castrates per litter originating from 5 organic and 9 conventional farms). At experimental farm, piglets were assigned within litter to three pens; one pen (ECO; n=14) received organic feed mixture (starter; 12.8 MJ metabolisable energy, 17% crude proteins), while two pens (CON, n=28) received initially (10 days) a conventional starter (14 MJ metabolisable energy, 17.8% crude proteins) and thereafter a grower diet (13.6 MJ metabolisable energy, 16.8% crude proteins). Piglets were fed ad libitum and weighed at the average age of 38, 54 and 113 days. In the pre-weaning period, the piglets grew faster on conventional farms (app. 20%) than on organic farms (LSM±SEM being 209±16 vs. 173±19 g/day, respectively), but the difference was not significant when taking into account the random effect of farm (P=0.17). Post-weaning, piglets fed conventional feed had 8% higher daily gain than piglets receiving organic diet (LSM±SEM being 391±31 vs. 361±41 g/day for CON and ECO, respectively; P=0.60). Our results suggest that no differences in growth rate of pigs between organic and conventional system are expected in the case of similar rearing and feeding conditions.

**Keywords:** Krškopolje piglets, growth rate, pre and post-weaning growth.

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PO - 1395

## PRODUCTIVE PERFORMANCE OF KRŠKOPOLJE PIG BREED – REVIEW PRELIMINARY RESULTS

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<sup>1</sup>KIS - Agricultural institute of Slovenia; <sup>2</sup>Faculty of Agriculture and Life Sciences, University of Maribor

**Abstract:** Local pig breeds are adapted to specific local environment and fed various locally available feedstuffs. So, besides their genetic merit for agro-biodiversity, they represent the basis for sustainable local pork chains. In terms of scientific substantiation, their performances and products are (for the majority of breeds) practically untapped. Thus the aim of the present study was to summarize data already available in the literature on production performance of the only Slovenian autochthonous breed of pigs - Krškopolje, which is one of the local pig breeds investigated in the project TREASURE\*. A collection and review of available literature data on productive traits (growth, carcass and meat quality) of Krškopolje pig breed was carried out. Literature review shows that growth rate of Krškopolje pigs from birth to slaughter is in average 492 g/day (339-637 g/day; n=6). In the studies described in the literature, slaughter was performed at the average age of 293 days (230-360 days; n=9) and 118 kg live weight (90-145 kg; n=7). Reported average dressing yield was 77.3 % (71.7-80.2 %; n=9) and lean meat content 43.5 % (37.5-47.8 %; n=7). Backfat thickness measured at the level of the last rib was in average 38 mm (28-53 mm; n=11), whereas loin eye area and loin eye fat area were in average 32.6 and 33.0 cm<sup>2</sup>, respectively (23.2-41.7; n=5 and 27.7-42.2; n=4; respectively). In the studies reporting meat quality of Krškopolje pigs, pH 24 h post-mortem in *Longissimus dorsi* muscle was in average 5.46 (5.28-5.60; n=7), drip loss 48 h post-mortem reached 5.1 % (3.9-6.7 %; n=4) and intramuscular fat content averaged 3.5 % (2.7-4.6 %; n=6). Although studies on Krškopolje pig are scarce, current review gives the first insight on productive performance of this local pig breed.

**Keywords:** Krškopolje pig, production performance, growth, carcass, meat quality.

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PO - 1396

## MORPHOLOGICAL AND REPRODUCTIVE TRAITS OF TUROPOLJE PIG BREEDING SOWS

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<sup>1</sup>University of Zagreb Faculty of Agriculture; <sup>2</sup>Croatian Agricultural Agency

**Abstract:** Turopolje pig (TP) is a native Croatian breed, created during the early middle ages in Turopolje region in Central Croatia. It is a medium-sized, primitive, fatty-type breed. Due to their modest rearing requirements, its resistance and good adaptation to local marsh meadows and oak forests, the TP breed has been an important food source for the local population for centuries. However, the rapid penetration of imported lean pigs in the second half of the 20th century, as well as the ban of forest grazing, significantly reduced the interest in this breed. The result was a drastic decrease in the population size. Currently, despite the state support, TP breed is still endangered, with a population of only 132 sows and 30 boars kept in 16 farms. Hence, a new strategy is needed for renewing the TP breed, based on purebred animals, which should be preserved as a resource for local livestock production and sustainable development. Unfortunately, few recent data on the morphological and reproductive traits of TP are available. The aim of this study, therefore, was to determine these traits on TP breeding sows (n=40) reared in a traditional outdoor system on a farm with the largest single herd of TP. The mean ( $\pm$ st. dev.) age (months) and body weight (kg) of sows were  $67.5\pm 26.0$  and  $96.6\pm 18.4$ , respectively. Height at withers and rumps, chest girth, body, head, ear and tail lengths were  $65.2\pm 2.8$ ,  $68.4\pm 2.9$ ,  $111.2\pm 10.4$ ,  $126.0\pm 5.2$ ,  $27.0\pm 0.90$ ,  $22.5\pm 8.3$  and  $29.9\pm 2.01$  cm, respectively. The average number of piglets born alive was  $4.47\pm 1.96$ , of which  $3.08\pm 2.17$  were weaned. The age at first farrowing was  $22.1\pm 7.9$  months. Data were collected within H2020 project TREASURE\*.

**Keywords:** Pig, Turopolje breed, morphological traits, reproductive traits.

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**PO - 1408**

## ALTERNATIVE BUILDINGS FOR FATTENING BÍSARO PIGS: HOOP BARN WITH FREE ACCESS TO OUTDOOR

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**Abstract:** The buildings used in traditional Bísaro pig farms limit the increase of the herd size per production unit. The aim of this study is to develop, to test and to demonstrate an alternative building system for fattening Bísaro pigs (hoop barn with free access to outdoor) respecting the good production practices, the animal welfare and the environment. The study, made within Treasure\* project took place at ESA-IPVC between november 2015 and june 2016. Thirty Bísaros pigs (from weaning until 120 kg BW) were installed in a hoop barn (ten animals for batch) with 90 m<sup>2</sup>(3 m<sup>2</sup>/animal) with free access to an outdoor park with 6000 m<sup>2</sup> (200m<sup>2</sup>/animal). The greenhouse was supported with a metallic structure, had opaque gray plastic top cover and it was sealed laterally with pine wood with 1,20 m high and 2,5 cm thick. The floor of the facilities was naturally obtained from soil along with straw (added every week at a rate of 1.5 kg/animal). The greenhouse was equipped with hoppers (40 cm for each pig) and in the parks, six nipples were placed at a height 55 cm from the ground. The outer park was circumscribed with electric fence constituted by three wires, located at 25, 40 and 60 cm from the floor. Inside the barn, the temperature and relative humidity were 13,0±5,2°C and 85,5±16,5% respectively, with slight variation in winter (10,9±4,0°C and 89,2±14,1%) and spring (15,7±5,3°C and 80,5±17,8%). The animals adapted very well to this housing system and responded with high levels of welfare and performances. The housing system has proved to be robust and there were no situations of animals no escape or erosion problems associated with any materials used in this alternative building.

**Keywords:** Bísaros, Buildings, Equipment, Welfare.

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PO - 1441



## **SESSION 3**

### **PRODUCTION SYSTEMS – NUTRITION AND REPRODUCTION**

#### **ORAL COMMUNICATIONS**

## **ADAPTATION OF A LONG-TERM, PRE-FINISHING MALE IMMUNOCASTRATION PROTOCOL TO THE ACORN-FEEDING FREE-RANGING SYSTEM (MONTANERA) OF THE IBERIAN PIG: EFFECTS ON REPRODUCTIVE PARAMETERS AND CARCASS TRAITS**

Francisco Ignacio Hernández García<sup>1</sup>; Mercedes Izquierdo<sup>1</sup>; Ana Isabel Del Rosario<sup>1</sup>; Ana Montero De Espinosa<sup>1</sup>; Miguel A. Pérez<sup>1</sup>; Javier García-Gudiño<sup>1</sup>; Juan Luis Duarte<sup>1</sup>; José María Contreras<sup>1</sup>

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**Abstract:** A voluntary ban on male pig castration is expected for most E.U. countries in 2018. However, standard immunocastration (**IC**) protocols still need to be modified for Iberian (**IB**) pig males due to their long life cycle. Our research group developed a 3-dose protocol that needs to be further adjusted to suit *montanera* (**MT**) chronology. Our hypothesis is that improving homogeneity of body condition at the start of MT will enhance and homogenize testicular atrophy. Control pigs (**C**; n=18 IB males) were immunized against GnRH at 10.5, 12 and 13.5 months of age (**m**). Treated pigs (**T**; n=17 IB males) were immunized at 10.5, 11.5 and 13 m, with a 15-day *ad libitum* (**AL**) feeding period starting at the 3rd dose. Both Groups started the MT period at 13.5 m, coinciding with the 3rd dose of C and the end of the AL period of T, and both were slaughtered at 16 m. To further ascertain the effect of nutritional level, an additional group was fed AL during the growth and finishing phases with commercial feedstuff in a regular extensive system (**AdLib**, n=15 IB x Duroc males), with the vaccinations taking place at 8, 9 and 10 m and the slaughter at 13 m (earlier, due to genotype and unrestricted feeding). *Postmortem* testicular weight and volume and epididymal weight were significantly smaller for AdLib and T than for C. Similarly, bulbourethral gland weight was significantly smaller for T than for C. Testicular parenchymal color "a" (green to red) was correlated ( $R^2=0.76$ ) with testis weight. Foreleg, loin and prime-cut yields were significantly greater for AdLib. In conclusion, nutritional level can be used to improve the efficacy of male IC, and testicular colorimetry can be used to monitor this efficacy.

**Keywords:** Immunocastration, reproduction, carcass composition, Iberian pigs.

This study was performed within Treasure project: "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."

**OC - 1431**

## **SESSION 3**

### **PRODUCTION SYSTEMS – NUTRITION AND REPRODUCTION**

#### **POSTERS**

## PERFORMANCE AND CARCASS CHARACTERISTICS OF IMMUNOCASTRATED AND SURGICALLY CASTRATED IBERIAN PIGS FED DIETS OF DIFFERENT PROTEIN CONCENTRATION

Isabel Seiquer<sup>1</sup>; Patricia Palma-Granados<sup>1</sup>; Manuel Lachica<sup>1</sup>; Luis Lara<sup>1</sup>; Ignacio Fernández-Fígares<sup>1</sup>; Ana Haro<sup>1</sup>; Rosa Nieto<sup>1</sup>

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**Abstract:** Immunocastration has proved to be an effective strategy to prevent sexual development and boar taint in pigs. Previous results indicate that immunocastrated (IC) pigs exhibit better performance than those surgically castrated (SC). In addition to animal welfare benefits, this fact could be of interest for Iberian pigs, as the growth capacity of castrates rapidly diminishes with age. The purpose of this study was to examine the effects of immunocastration on Iberian pig performance, protein utilization, and carcass traits under different dietary protein concentrations. Twenty-seven pure Iberian pigs were used (3 sexes: IC males, IC females, SC males; 3 isoenergetic diets: 160, 140 and 120 g CP/kg DM; 3 pigs/group). Pigs were vaccinated against gonadotrophin releasing factor at 4.3 (40 kg) and 6 months of age (70-80 kg). Experimental diets were given to individually housed pigs from 40 to 100 kg-BW. Digestibility and N-balance assays were performed at 50 and 90 kg BW. At 100 kg, pigs were slaughtered. Preliminary results indicate greater growth rate for IC males than for SC males and IC females (803 vs 706 and 696 g/d, respectively;  $P < 0.001$ ). Feed efficiency (G:F) was also greater for the IC males (similarly, 0.289 vs 0.260 and 0.263;  $P < 0.01$ ). IC males exhibited increased carcass length, greater yields (relative weights with respect to carcass) of loin, sirloin and shoulder, but decreased carcass yield (with respect to BW) than the other groups. In contrast, no relevant differences related to the 3 dietary treatments were detected. Further results involving more pigs and metabolic and transcriptomic determinations will help to elucidate the nature and effects of immunocastration on Iberian pig lean growth.

**Keywords:** Iberian pig, immunocastration, performance, dietary protein.

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PO - 1388

## PROTEIN REQUIREMENTS OF CINTA SESESE PIGS FROM 30 TO 60 KG: PRELIMINARY RESULTS

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**Abstract:** Protein requirements of pigs during the first phase of life is crucial for both achieving high growth rates and avoiding nitrogen waste. Autochthonous breeds possess specific requirements in this regard and the literature is poor even for the Cinta Senese breed. Thus the effect of different level of crude protein (CP) in Cinta Senese pigs, between 30 and 60 kg, was evaluated within the TREASURE\* project. Twelve male pigs were individually reared indoor, fed with four isoenergetic diets with different levels of CP (18, 16, 14 and 12%) equally distributed among animals. The animals, with an initial average live weight of 27 kg, were fed *ad libitum* and slaughtered after 2 months of trial. Left side of carcass was sectioned in six cuts: head, neck, loin, shoulder, leg and ribs. Each cut has been dissected into the main tissues. As regards *in vita* performance a slightly higher growth rates with decreasing protein levels were recorded (64.2, 62.3, 61.5 and 60.7 kg of slaughter weight with an ADG of 0.700, 0.690, 0.660 and 0.647 kg/d respectively for 12, 14, 16 and 18% of CP), though only the two extreme levels of CP (12 vs 18%) resulted statistically different. Cuts weights and the percentage of the main tissues were similar between diets. Replication of the trial expected for the next autumn could provide better insights.

**Keywords:** Protein requirements, Cinta Senese pig, Growth rate, Carcass composition.

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PO - 1425

## FIRST REPRODUCTIVE AND PRODUCTIVE RESULTS ON “RIBATEJANO PIG”

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**Abstract:** The present trail aimed to study the effect of crossbreeding between Alentejano (AL) and Bísaro (BI) swine breeds (“Ribatejano pig”) on some reproductive and productive traits. Nine AL gilts and sows and six BI gilts were crossed with BI and AL boars, respectively. Mating and farrowing dates, prolificacy and litter size at 28d were registered for all sows. The pregnancy length of AL sows was shorter ( $111\pm 0.4$ d vs  $113.7\pm 0.5$ d;  $p=0.002$ ) than the observed on BI females. The BI gilts presented higher prolificacy rate than AL on both total born ( $11.0\pm 1.0$  vs  $6.7\pm 0.8$ ;  $P=0.004$ ) and born alive piglets ( $10.0\pm 1.0$  vs  $6.7\pm 0.8$ ;  $p=0.026$ ). The mortality rate was similar in both genotypes ( $p=0.255$ ) being on average 12%, therefore at 28d after farrowing the litter size remained higher in BI sows ( $8.5\pm 0.8$  vs  $6.1\pm 0.6$ ;  $p= 0.032$ ). A subset of each genotype (4 gilts) was supervised during farrowing and lactation (until 28d) and piglets were weighed at birth, 24h and 28d of live. Farrowing length was not significantly different ( $p=0.253$ ) between genotypes, averaging  $97\pm 22$  min. When compared to ALBI (AL x BI) piglets, the BIAL (BI x AL) piglets were heavier at birth ( $1402\pm 46$ g vs  $1209\pm 36$ g;  $p=0.002$ ). Colostrum intake of piglets per kg of birth weight on the first 24h of life was similar between genotypes ( $p=0.735$ ) being  $289\pm 15$ g for ALBI and  $281\pm 19$ g for BIAL piglets. The growth rate of piglets from birth to 28d and piglet weight at 28d was not different between genotypes ( $p=0.161$  and  $p=0.091$ ) averaging  $195\pm 6$ g and  $6761\pm 181$ g, respectively. Litter weight at 28d tended ( $P=0.06$ ) to be higher on ALBI litters ( $56.6\pm 4.0$ kg) than BIAL litters ( $43.2\pm 4.0$ kg). This results obtained within the frame of Treasure project\* are, at our knowledge, the first data of these crossbred piglets and could be used in future as reference for further studies and also for farmers that may try these cross on a commercial basis.

**Keywords:** Alentejano swine breed, Bísaro swine breed, crossbred piglets.

\* 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.

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## THE RIBATEJANO PIG – REBIRTH OF A LOCAL PIG POPULATION? FIRST RESULTS ON GROWTH, CARCASS AND MEAT PARAMETERS

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**Abstract:** A former cross between Alentejano (AL) and Bísaro (BI) breeds, called Ribatejano pig (RI), was quite spread in Ribatejo region until half of the last century and was raised in both borders of Tagus River. Besides the renewed interest of this cross nowadays, no performance data is available regarding the RI (ALxBI and BixAL) animals or their products, which were studied in the frame of project TREASURE\*. In order to assess the productive performance of the RI pig, castrated AL, BI, ALxBI and BixAL pigs (10 from each genotype) raised in traditional free-range system and fed commercial diets *ad libitum*, were slaughtered at ~65kg LW. Preliminary data show that BI, ALxBI and BixAL attained the slaughter weight faster ( $P<0.001$ ) than AL. Overall, carcass length ( $P<0.001$ ), carcass dressing ( $P=0.06$ ), and lean cuts weight ( $P<0.01$ ) were higher in BI than AL pigs, with ALxBI and BixAL pigs presenting intermediate values. Conversely, fat cuts weight, ZP fat depth ( $P<0.01$ ) and average backfat thickness ( $P<0.001$ ) were higher in AL than in BI, and ALxBI and BixAL pigs. *Longissimus lumborum* drip loss was higher in BI, as well as lightness and hue angle ( $P<0.001$ ). Curiously, redness, yellowness, chroma and saturation values from ALxBI and BixAL pigs were higher ( $P<0.001$ ) than those of pure genotypes. Besides that, preliminary data indicate that at 65kg LW, RI crossed pigs presented intermediate characteristics between the fatter (AL) and the leaner (BI) genotypes. This cross could therefore be an alternative to the use of other breeds on commercial crosses, helping to increase the revenue of autochthonous pig producers, and also maintain or increase the pure breed populations, contributing to animal biodiversity.

**Keywords:** Ribatejano Pig, Productive Performance, Carcass parameters.

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## **SESSION 5**

### **FOOD TECHNOLOGY, MEAT QUALITY AND PRODUCTS**

#### **POSTERS**



## **CINTA SENESE BURGERS WITH OMEGA-3 FATTY ACIDS: EFFECT OF STORAGE AND TYPE OF ENRICHMENT ON QUALITY CHARACTERISTICS**

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**Abstract:** In Cinta Senese meat, polyunsaturated fatty acids (PUFAs) only consists in the 10-11% of total fat. Moreover the eicosapentaenoic and docosahexaenoic acids, which are two of the most important omega-3 PUFAs to human health, are not present in pork meat, but they are very abundant in fish products. According to TREASURE\* project the aim of this work was to enhance Cinta Senese meat healthiness by adding microencapsulated fish oil (M) and bulk fish oil (F). Three groups of burgers were prepared: M (n=15), F burgers (n=15) and C control (without addition) (n=15). Each group was split in three sub-groups of 5 burgers and submitted to three different storage conditions: one group(n=15) was immediately examined (T0), one was preserved during 5 days at +4°C (T5), the last one during 30 days at -20 °C (T30). Physical-chemical and sensory attributes of enriched burgers were investigated after cooking. M burgers showed significantly higher amount of PUFAs at T0 and T5, in particular omega-3 PUFAs resulted significantly higher in M samples at T0, T5 and T30. TBARs resulted to be influenced by addition, with significantly higher values in F added burgers. Sensory analysis were carried out by 18 trained panelists who detected no differences over addition at T5 and T30; contrariwise, at T0 significant differences affecting off odor and off flavor were observed. In conclusion, fish oil microencapsulation technique appears to be an effective method to fortify meat in omega-3 fatty acids, protecting added PUFAs from oxidation without influencing burger sensory attributes.

**Keywords:** Pig, Cinta Senese, omega-3, meat quality.

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## **SESSION 6**

### **SOCIO-ECONOMIC ASPECTS**

#### **KEY-NOTE LECTURE**

## IMPROVING SUSTAINABILITY OF LOCAL PIG BREEDS USING QUALITY LABELS – CASE REVIEW AND TRADEMARK DEVELOPMENT IN PROJECT TREASURE

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**Abstract:** The interest for traditional genetic resources, here comprised local pig breeds, has been increased for the last few decades. Yet, at the time being, majority of local pig breeds still need to be supported with subsidies in order to ensure their conservation. However, the best strategy is to have breed self-sustaining i.e. exploit the quality attributes and reputation of their products which denotes the importance of marketing strategy and intellectual property (IP) protection. IP refers to the rights associated with creations of the mind and includes also trademarks and geographical names with pros and cons for specific situations. In EU there are few success cases of using local pig breeds but the majority of breeds studied in project TREASURE remain untapped. Thus the ambition of the project TREASURE\* is to develop a collective trademark that could represent a new “umbrella” including all breeds and pork chain products involved in the project (and open to other local breeds). The collective trademark will play a key role as it should represent a starting point for the definition of sustainable pork chain. Major socio-economic aspects related to the implementation of the collective trademark include rights, responsibilities and expected added value for end-users. TREASURE collective trademark is conceived on existing European Intellectual Property Systems, securing protection and recognition at international level: the "Madrid system" issued by WIPO and the European Union Trade Mark issued by EUIPO. Based on the results obtained by an internal survey conducted in TREASURE, we have identified the main features of the collaborative trademark: 1) it should attract end-users such as farmers, breeders associations and meat processors; 2) it should be developed and promoted by an operational committee of end-users, under the coordination and supervision of TREASURE Consortium; 3) it should emphasize local pig genetic resources as the key common point within the procedural guidelines, considering also other relevant aspects such as production systems and nutrition; 4) it should also explore possible collaboration or conflict with existing EU protected products (PDO, PGI, TSG) in order to optimally promote local products. The strategy to build-up the trademark will be presented involving all end-users possibly interested in joining the umbrella trademark.

**Keywords:** trademark; intellectual property; sustainability; local pig breeds; commercial exploitation.

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## **SESSION 6**

### **SOCIO-ECONOMIC ASPECTS**

### **ORAL COMMUNICATIONS**

## TYOLOGY OF THE NOIR DE BIGORRE PIG FARMING SYSTEMS

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**Abstract:** Intensive pig production systems are facing economic and environmental challenges that outdoor systems relying on local pig breeds may overcome. The Noir de Bigorre (NDB) pork chain located in South West of France is organized as a cooperative including farmers and processors. NDB products recently obtained national “AOC” label required for Protected Designation of Origin (PDO) registration. Therefore, within the European TREASURE\* project, a typology of the NDB pig farming systems was constructed for further evaluation of their sustainability. A dataset was built including the 49 active farms involved in the chain. The dataset contained information on farm size, farm grassland and woodland areas, seniority in the chain, number of sows, piglets and pigs produced per year as well as proportion of on-farm produced feed. Principal Component Analysis (PCA) and Hierarchical Clustering (HC) were performed on these data. The first and second axes of the PCA explained respectively 39% and 34% of the variability. HC constructed 4 classes, with class 1: small farms with high seniority in the chain (n=19), class 2: pig breeding farms with small grassland / woodland areas (n=13), class 3: pig fattening specialized farms (n=9) and class 4: large farrow-to-finish farms with lowest seniority in the chain and highest proportion of on-farm feed production (n=8). This typology highlights the structure and the dynamics of the NDB farming systems. The expected evolution includes large farms (class 4, producing the maximum yearly number of pigs allowed in the PDO), with a fattening unit or both farrowing and fattening units. The typology will be useful for further sustainability assessment of the NDB pork chain.

**Keywords:** Gascon breed, Outdoor, Hierarchical clustering, socio-economic dynamics.

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