Local Pig Breeds: Nutritional Requirements, Innovative Practices and Local Feeding Resources as Challenges in Project TREASURE

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Summary

TREASURE is a research and innovation project of European Union's Horizon 2020 programme which is devoted to traditional genetic resources in pig production with aim to improve their potentials for enhanced use. Studying and improving management of local pig breeds in their production systems is one of the challenges in which we address their performances and nutrition with special attention on locally available feeding resources and innovative practices aiming to improved welfare. For that purpose 15 experiments on 12 breeds were designed in the project, which are hereafter shortly presented. Their concepts and main objectives with some highlights on already available results are described.

Key words

pig, local pig breeds, nutritional requirements, management innovations, feeding resources

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Introduction

The inherent value of European local pig breeds and production systems represent not only the exceptional agricultural biodiversity but are also prerequisite for the unique high quality pork products, for which there is an increased consumer demand. However, despite a constant increase of general interest for local breeds, with few exceptions, they remain rather poorly investigated and exploited. Project TREASURE (www.treasure.kis.si) aims to bridge that gap and proposes the activities in support of the development of untapped local pig breeds. To improve their sustainability, it is important to get scientific assessment of their productivity and product quality and to study their nutritional requirements, evaluate locally available feeding resources and to test innovative feeding and management practices.

Objectives

Unlike for modern breeds, the knowledge on growth performance and nutritional needs of local pig breeds is very limited. There have been some studies showing their specific metabolic characteristics compared to conventional pig breeds (Fernández-Fígares et al., 2007) and their lower growth rates and lean-tissue deposition (Barea et al., 2007). This particular metabolic profile implies that they also have specific nutritional requirements. Optimum protein/energy ratio for growing/fattening Iberian pigs has been studied (Nieto et al., 2012). However, additional studies on various production phases and on other local pig breeds are demanded. Therefore, nutritional requirements according to production (physiological) stage are assessed using metabolic studies or using InraPorc® software and available data. Strategic project objectives are also related to improved quality and healthiness aspects of pork products by means of innovation in management and feeding strategies. In Iberian pigs, the traditional "montanera" system implies a compensatory growth effect, whereas in other breeds this will be experimented as innovative approach. This manoeuvring of growth is expected to increase intramuscular fat, a key factor for improved sensory quality of pork (Lebret, 2008). Pig production systems based on local breeds are able to respond not only to the high expectations of consumers for high quality products but also to the increasing demands of modern society towards animal welfare issues. Housing systems are investigated, not only to evaluate performances and welfare but also to identify areas for future developments. An important welfare issue is pig castration, (common practice to prevent boar taint), which is presently being questioned in the EU. Immunocastration (active immunization against gonadotropin-releasing hormone [GnRH]) has been proven as effective in prevention of sexual development and boar taint in conventional pigs, but it affects also performances, carcass and meat quality (Batorek et al., 2012). Immunocastration seems to be a particularly interesting alternative for heavier, older pigs (Čandek-Potokar et al., 2017) or in the case of gilts (gonadectomized to prevent unwanted oestrus or pregnancies in outdoor systems). Longer productive cycle in heavier and older pigs makes the use of immunocastration more complex and requires investigations to develop adapted vaccination protocols and evaluate consequences on performance and product quality. Evaluation of locally available feed resources is one of the major experimental tasks which involve many studied local pig breeds. The main aim is to evaluate the benefits for pork products. However, in the Iberian pig, the studies concern the use of locally available by-products rich in fibers for welfare reasons, i.e. for satiety of pigs in the period of restricted feeding prior to acorn pasture ("premontanera"). The experiments (n=15) focus on performances and management of local pig breeds (n=12) and are closely connected with tasks on product quality evaluation and genetic characterisation. A common toolbox is used for evaluation of carcass, meat and product quality. In cooperation with genetic tasks some pilot studies on gene expression as related to immunocastration and specific local feeding resources are carried out, and metagenomic assessment of intestinal microbiota as related to diet and breed is also studied. Namely, the composition of the intestinal microbiota is due to the diet, environmental factors and the host (Isaacson and Kim, 2012).

Review of experiments

Nutritional requirements of growing pigs and reproductive sows

Little is known about the nutritional requirements of local pig breeds which were not submitted to genetic selection for fast growth and leanness. Available studies were performed mainly on Iberian breed. Metabolic experiments conducted in TREASURE (Table 1) concern two local pig breeds (Iberian and Cinta Senese) and comprise studies on protein requirements of i) Cinta Senese growing pigs, ii) Iberian immunocastrated males and female growing pigs, and iii) Iberian lactating sows. Complementary modelling studies using data available from experiments in other breeds are also planned to determine pig nutritional requirements at different physiological stages using the InraPorc® software.

Innovative practices and their effects

Experiments aim to evaluate the effects of innovative practices in management and feeding on production traits, product quality and animal welfare (Table 2). Innovative practices addressed in the project are compensatory growth, being studied in Cinta Senese through protein restriction during fattening; zootechnical evaluation of crossing between two Portuguese breeds: Alentejana and Bisara which used to cohabit in region Ribatejo and where crosses between both breeds were a common practice (revival of Ribatejano); immunocastration as welfare friendly alternative for Iberian pig with emphasis on utility for "montanera" rearing system (improvements of vaccination protocols). Immunocastration is also tested in Mangalitsa breed.

Housing conditions and their effects

Local pig breeds are known to exhibit lower growth rates than conventional breeds. However, as they are kept in a variety of production systems it is difficult to evaluate and compare their growth potential and performances at equal basis. Basic data about their performances in various systems based on scientific grounds is needed. Housing conditions are also important from the welfare perspective. Various experiments with different objectives according to breed were thus designed to evaluate effects of housing conditions (Table 3). Ecological and conventional rearing systems are compared in Krškopolje pigs,

Table 1. TREASURE experiments to evaluate protein requirements

Objective	Breed	Highlights on first available results
Protein requirements in immunocastrated males and females	Iberian	No differences in growth and performance have been detected among the protein treatments (12-16%) assayed. Plasma urea decreased in pigs of three sexes fed on lower protein diets N balance results will elucidate if protein requirements differ among immunocastrated and surgically castrated male pigs.
Protein requirements in lactating sows	Iberian	No results available yet
Protein requirements in growing pigs	Cinta Senese	Growth rate (30-60 kg) was higher in pigs fed iso-energetic diet with less proteins (12 vs. 18% proteins) Cuts weights and the percentage of the main tissues were similar between diets.

Table 2. TREASURE experiments aiming to evaluate innovative practices

Objective	Breed	Highlights on first available results
Compensatory growth	Cinta Senese	Protein-restricted-pigs showed higher slaughter weight due to greater lipid deposition pointed out by higher proportion of subcutaneous (inner layer) backfat. Further analysis will be carried out to determine the intramuscular fat deposition.
Zootechnical performance of Ribatejano crossing Alentejano×Bísaro (AL×BI) Bísaro×Alentejano (BI×AL)	Crossing Ribatejano	AL×BI piglets were heavier at birth than BI×AL. Colostrum intake, mortality rate during lactation and weight at 28 days were similar in both crosses In the first growth period (30-65kg) AL pure breed pigs had a lower average daily gain than pure breed BI and both crosses (which were similar) In the second growing and fattening period (65-150kg) the average daily gain was similar in all genotypes
Immunocastration – efficacy of adapted vaccination protocol to "montanera"	Iberian	Short-time (15 days) ad libitum feeding before finishing "montanera" phase increased the efficacy of immunocastration to 100% as shown by deeper and more uniform testicular atrophy, and no androstenone Testicular parenchyme colour (CIE a) was highly correlated (r=0.87) with testicular weight
Immunocastration – effect on performance and nutritional requirements	Iberian	12 % higher daily gain (40-100 kg) and feed efficiency (10%) in immunocastrated than surgically castrated males Immunocastrated males showed higher proportion of lean cuts (loin, sirloin, butt lean) and carcass length than surgically castrated males
Immunocastration – effect on performance	Mangalitsa	No differences in overall growth rate between immuno and surgical castrates, nevertheless growth rate was higher in immune than surgical castrates after second vaccination

Table 3. TREASURE experiments to evaluate effect of housing conditions

Objective	Breed	Highlights on first available results
Comparison of performances in ecological and conventional system (from 70 kg onwards)	Krškopolje	In equivalent dietary conditions, pigs reared according to ecological standards exhibited 10% higher daily gain; Fat tissue deposition intensifies in Krškopolje pigs at 70-80 kg live weight; Ultimate pH lower (muscle energy reserves higher) in pigs reared according to organic/ecological production rules; Pigs in ecological rearing system showed different myosine heavy chain expression.
Performances in indoor and outdoor system	Schwäbisch-Hällisches	In equivalent dietary conditions, pigs reared outdoor were slightly more uniform regarding carcass traits (eg lean meat content) than indoor reared pigs
Alternative housing system, performances and welfare	Bísaro	Alternative housing with hoop barn (and outdoor access area) was developed Similar growth performance was observed in hoop barn and standard confinement rearing system
Performances in indoor and outdoor system; Development of body composition in pigs kept in indoor system	Black Slavonian	The growth of pigs kept indoors was mainly affected by the increase in fatty tissue; Outdoor raised pigs are characterised by low daily gains of live weight and fat. Muscle tissue seems to persist in growth even in the late stages, although at low rate.

outdoor and indoor production in Schwäbisch-Hällisches pigs. Hoop barn (Figure 1) with access to open area compared to a confined system is tested in Bísaro pigs. In addition to performances, housing systems are also evaluated from the welfare point of view. In Black Slavonian the goal is to analyse development of body composition in conventional indoor in comparison to traditional outdoor production system.

Figure 1. Hoop barn with outdoor access developed and tested for Bísaro pig (Araujo et al. 2016; doi: http://dx.doi.org/10.3920/978-90-8686-834-6_12)

Table 4. TREASURE experiments aiming to evaluate feeding resources

Feeding resource	Breed	Highlight on first available results
Lucerne hay	Krškopolje	Fat tissue of pigs supplemented with lucerne hay had more vitamin A and n-3, n-6 polyunsaturated fatty acids
Root crops	Krškopolje	Feeding with root crops and cereals showed strongly reduced growth rate compared to pigs fed concentrates
		More intense m. longissimus colour (lower CIE L, higher CIE a)
Acorns	Schwäbisch-Hällisches	20% replacement of standard diet with acorns had no effect on carcass characteristics;
		Data on meat quality and growth is in progress
Acorns	Turopolje	30% replacement of standard diet with acorns had no effect on fatty acids of backfat, but increased saturated fatty acid content of intramuscular fat
		Strong effect was noted on gut microbiota
Tannin rich wood extract	Mangalitsa	2% diet supplementation with tannin rich wood extract resulted in 12% decrease in growth rate
		Analyses of meat quality are in progress;
Olive by-product "alperujo"	Iberian	The use of olive by-products (in dry or wet presentation) during growing period as a substantial component of the diet did not affect the commercial slaughter weight nor carcass composition after fattening "montanera" period (acorn and grass). Results are similar to traditional restricted feeding system.
Rice husk	Iberian	Three groups varying in level of fibers were tested in "premontanera" phase (10-14 months of age), without any diarrheic problems;
		After the initial 2-month period, daily gain until the end of "premontanera" was greater for High fiber group, which also exhibited steadier (in time) and more homogeneous (among animals) growth rate.
Potatoes	Bísaro	No results are available yet; analyses of meat quality are in progress
Germinated seeds		
Season: spring/winter (availability of feedstuffs)	Gascon	No effect of season was observed on growth rate;
		Pigs slaughtered in winter had slightly fatter carcasses;
		Ultimate pH was lower in winter slaughtered pigs (higher muscle energy reserves);
		Intramuscular fat content was not affected in loin but was higher in ham of pigs slaughtered in spring;
		Ratio of n-6/n-3 fatty acids was reduced in both subcutaneous fat and muscle tissues of spring slaughtered pigs
		Analysis of pigs slaughtered in autumn is in progress

Local feeding resources and their effects

Experiments are set to evaluate the feeding with locally available resources rich in natural antioxidants (e.g. pasture, grass/hay, tannin rich wood resources or extracts) or value of agro-by-products (e.g. olives, potatoes, fibre sources) for fattening local pig breeds (Table 4). Thus, in Krškopolje pigs the effect of supplementing the diet with lucerne hay and traditional way of feeding cooked root crops was studied, acorn addition was studied in Schwäbisch-Hällisches and Turopolje pigs, tannin rich wood extract supplementation in Mangalitsa pigs, potatoes and germinated seeds supplementation in Bísaro pigs. In Iberian pigs, for "premontanera" period when restricted feeding is applied, fiber rich rice husk and "alperujo" (by product of olive oil pressing) were tested. In the case of Gascon breed the effect of season was evaluated (pigs slaughtered in winter, spring and autumn), which denotes availability of different feeding resources according to season.

Conclusion

Different experiments conducted in the project for many untapped local breeds represent the first results on their performances in a controlled experimental environment. Preliminary results show that growth potential of local breeds is often underestimated and that growth rate is higher than expected in the intensive systems (feeding complete feed mixtures). For better understanding of nutritional requirements of local pig breeds (which were not genetically selected for lean tissue growth) Iberian or Cinta Senese breeds are considered here as models in the pilot studies conducted. Tested innovations will improve knowledge about the alternative solutions in production systems with local pig breeds for the future. Investigations with feeding of locally available resources will contribute to the body of knowledge about their exploitability and benefits for special production systems with local pig breeds.

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