

LOCAL PIG BREEDS AND PORK PRODUCTS IN CROATIA AND SLOVENIA – UNEXPLOITED TREASURE

Kušec, G.⁽¹⁾, Dovč, P.⁽²⁾, Karloyi, D.⁽³⁾, Čandek Potokar, M.⁽⁴⁾

Scientific review

SUMMARY

The rationale, the concept and key challenges of the H2020 project TREASURE dealing with local pig breeds is presented and discussed. The action addresses the phenotypic and genetic characterisation, performance of local pig breeds in diverse production systems and their environmental impact, specific quality of their products and market potential. The goal is to build up the capacities to develop sustainable pork chains based on local pig breeds. A special emphasis is given to describe the workplan for Black Slavonian and Turopolje local pig breeds from Croatia and Slovenian Krško polje pig.

Key-words: sustainable pig production, local pig breeds, product quality

INTRODUCTION

Pig meat is the main product of meat sector in the European Union. In 2013 almost 22 million tonnes of pork was produced within EU-28 which is three times higher than the production of beef/veal (Eurostat, 2014). Such production needs highly effective pig production. Pork production is concentrated in few EU regions; in 2013 a quarter of its production was recorded in Germany (24.9 % or almost 5.5 million tonnes) followed by Spain (15.6%) and France (8.8%). Notable production of pork was recorded also in Poland and Denmark with the shares of 7.7% and 7.2%, respectively (Eurostat, 2014). Owing to that, EU has a self-sufficiency of about 110% and exports about 12% of its total production. These results make currently EU the world's second biggest producer of pig meat after China and also the biggest exporter. In relation to the production system most of the pigs in EU are fattened in intensive systems, i.e. on large farms with three quarters of pigs produced by just 1.5% of the largest farms (Marquer et al., 2014). The trend of concentration of the pig production on large farms is due to economic reasons (farms fixed

costs are divided by a larger number of animals which consequently increases productivity and reduces the average cost of production). Such efficiency would not be achievable without technological advances. Modern pig production needs a variety of experts to handle the issues of herd health, production management, waste management, reproduction, genetics, nutrition, meat quality and safety, business management and more. It is clear that technological advances could not be achieved without growing knowledge and innovative ideas founded on scientific research. Indeed, the most advanced tools are today in everyday use for the improvement of economically important traits of pigs. For example, the genetic gain on body composition of breeding pigs is extensively studied by means of computed tomography (CT) as it is used in Norway as a part of Norsvin breeding system where 3500 boars are scanned annually (Kongsro, 2014). The same author reported an estimated 30% increase of genetic gain on lean meat percentage by the use of this non-invasive technology for collecting the data for phenotyping *in vivo*.

The development in pig production worldwide followed exactly the same scenario during the last 40 years. This situation caused spreading of genetically improved, productive pig breeds on a global scale and a reduction of population size in many local breeds which are less performing and some of them are nowadays close to extinction. However, the above described trends in a modern pig production, resulted in lower quality of their products, lower resilience and

(1) Prof. Dr. Goran Kušec (goran.kusec@pfos.hr) - University of Josip Juraj Strossmayer in Osijek, Faculty of Agriculture, K. P. Svačića 1d, 31000 Osijek, Croatia (2) Prof. dr. Peter Dovč - University of Ljubljana, Biotechnical Faculty, Jamnikarjeva 101, 1000 Ljubljana, Slovenia (3) Assoc. Prof. Danijel Karolyi - University of Zagreb, Faculty of Agriculture, Svetošimunska cesta 25, 10000 Zagreb, Croatia (4) Ph.D. Marjeta Čandek-Potokar - Agricultural Institute of Slovenia, Hacquetova ulica 17, 1000 Ljubljana, Slovenia

robustness, larger farms were often not able to solve problems related with handling of animal wastes causing pollution and animal welfare issues which are more and more important for the consumer. One of the first reactions to this development were different initiatives for preservation of small local breeds from extinction and how to make them competitive in modern animal production. Some governments tried to achieve this task with financing in-situ conservational farms e.g. direct payments to the breeders of local breeds but this was a relatively expensive solution and cannot give a warranty for preservation of a large number of local breeds.

To demonstrate an alternative a new paradigm of pig production was proposed in a Horizon 2020 project TREASURE aiming to improve the knowledge, skills and competences necessary to develop existing and create new sustainable pork chains based on European local pig genetic resources (local breeds).

To achieve this goal, we will try to find good answers to the following questions:

- What is the value of traditional local breeds and production systems they are held in?
- Are local breeds and their diversity valuable for the food chain?
- How can we bring biodiversity to the market and ensure that the consumer will recognize this value and appreciate it?

In this project the breeds from Croatia and Slovenia are also included, namely the Black Slavonian (Crna slavonska svinja), Turopolje (Turopoljska svinja) from Croatia and Krškopolje (Krškopoljski prašič) from Slovenia. In the past years due to many efforts these breeds have been preserved from extinction. However, they remain untapped, with their potential little explored and exploited. This denotes a special interest of the stakeholders to benefit as much as possible from the activities and network of the TREASURE project. Following is the description of the project activities scheduled for these breeds.



Figure 1. Croatian local pig breeds Black Slavonian (left), Turopolje (middle) and Slovenian local pig breed Krškopolje breed (right) will be studied in H2020 project TREASURE

 <p>TREASURE</p> <p>Diversity of local pig breeds and production systems for high quality traditional products and sustainable pork chains</p>  <p>Funded by European Union Horizon 2020 Grant agreement No 634476</p>	<p>Start of the action: 1 April 2015</p> <p>Duration: 48 months</p> <p>Budget: 3,395,986.75 EUR</p> <p>25 partners from 9 countries</p> <p>Coordinator: Kmetijski inštitut Slovenije = Agricultural Institute of Slovenia</p> <p>www.treasure.kis.si</p>
---	---



Figure 1. Basic data about the project, partners and local pig breeds involved

PHENOTYPIC AND GENETIC CHARACTERIZATION OF BLACK SLAVONIAN AND TUROPOLJE BREEDS FROM CROATIA AND KRŠKOPOLJE BREED FROM SLOVENIA

In the project more than 20 local breeds (60 animals per breed) shall be studied which differ considerably in regard to their exploitation. Also the amount of information available for certain breeds is very different. In some breeds, as is the case of Black Slavonian, Turopolje and Krškopolje breeds, only scarce phenotype and population data are available but in other breeds, mainly those commercially more exploited (e.g. Iberian) even some molecular data are available. The basic phenotypic characterisation and establishing of population census will be the first step in our analysis. Our goal will be to use already existing information and to complete it with new data which will be collected during the project. We will try to collect also production data reflecting various production traits (growth performance, reproductive traits, body composition, and product quality). In addition to these standard traits we will establish also collection of some new types of data as adaptability, gut microbiota and some metabolic parameters. To get the basic information about the genetic richness of the population we will perform high throughput genotyping from each breed using high density SNP chips. Also, we will collect already existing information about STR allele frequencies in some breeds. In order to discover genetic

background for production traits we will estimate allele frequencies of the known major genes (IGF2, RYR1, MC4R, PRKAG3, LEPR, MC1R, KIT, CALP, FTO). Since the adaptive traits are more and more of interest for pig breeders, we will try to compare genomic information of local, well adapted breeds with modern breeds using genome sequencing strategies. We will sequence several animals from each breed in order to identify genomic regions involved in shaping of adaptive traits. Based on these data we will develop a panel of DNA markers which will be useful for breed authentication and traceability of animal products. Our ambition is also to develop a custom DNA chip which will allow cheap genotyping of loci informative for breed identification and for characterisation of genetic base for important production and adaptive traits.

In order to better understand the physiological base of production traits which are also reflected in the quality of products we will perform some pilot functional studies on gene expression in selected pig populations with the best developed characterisation of specific products. This will allow us to identify population specific physiological processes affecting product quality. In addition, we will also investigate changes in gene expression related to diets, immunocastration and some technological parameters using RNA sequencing. The most promising effects will be validated using quantitative PCR. Finally, as an important factor determining pro-

duction parameters, the intestinal microbiota as a part of complex biological system will be analysed. Using massive parallel sequencing technology (e.g. Illumina's MySeq or Roche's 454) we will characterise 16S rRNA sequences in gut microbiota in order to establish proportions of main microbial taxa in different combinations of host genotype and specific diet.

PERFORMANCE AND MANAGEMENT OF BLACK SLAVONIAN, TUROPOLJE AND KRŠKOPOLJE BREED IN THEIR PRODUCTION SYSTEMS

Along with genetics, production system is the most important factor that affects all traits of interest for pig breeders. Unlike in modern breeds, there is a general lack of information about housing and nutritional requirements of local pig breeds. In particular, such information is lacking in Black Slavonian, Turopolje and Krškopolje breed. In Europe, rather wide variety of productive systems used in rearing of local pig breeds exists: indoor, outdoor housing, organic production, silvopastoral systems, deep litter; all of these are worth and will be investigated systematically. For small scale pig production farms or family farms it is reasonable to assume that a simpler, less capital-intensive systems are more suitable, and if their products have higher quality (as expected by consumers) the chances of profitability can be increased. Budimir et al. (2013) described the possibilities of silvopastoral keeping of the Black Slavonian pigs as cost effective, environmental and animal friendly system which can result in improved meat quality traits and nutritional characteristics of pork products. As the main shortcomings of such production system authors stressed the possibility of mating with wild boars and transmission of contagious diseases, which are common risks in outdoor pig farming systems, as recently reviewed by Salajpal et al. (2013). Also, the knowledge on growth and performance of local pig breeds is very limited. For example, the growth characteristics of pigs kept under ad libitum and restricted feeding regimes were studied by Kušec et al. (2007a); models for prediction of optimal slaughter weight/age were given and their accuracy was demonstrated on modern hybrids (Kušec et al., 2007b; Vincek et al. 2012). However, such investigations were never carried out on indigenous breeds. Within a scope of investigations to be carried out in Croatia during the project TREASURE growth characteristics, fattening traits, carcass traits and meat quality traits will be studied on Black Slavonian pigs kept in two different housing systems – outdoor and indoor (deep litter). It is expected that in this manner information crucial for decision making in the production of Black Slavonian pigs and pork products will be collected and shared with scientific and professional public.

Research on local Turopolje pigs will be directed at high quality meat products development, which may represent a new and effective model for recovery and long-term conservation of this still endangered breed on economically sustainable base. For development

and market success of distinguishing, value-added pork products from local pig breeds it is, however very important to establish the link between the traditional production systems (e.g. outdoor pig farming) and its natural feed resources (e.g. forest, pasture) with the distinctive physical, sensory and/or nutritional attributes (e.g. more polyunsaturated fatty acid profile) of product. Hence, information about aspects benefiting to product quality can be used as a relevant differentiation tool in marketing of such products (Edwards, 2005). Hence, in the present project, the influence of traditional feeding resources of oak (*Quercus robur*) acorns in outdoor production system will be investigated in relation to various aspects of Turopolje breed performances and meat/product quality.

Similarly, an experiment will be performed comparing performance, carcass and products' quality from Slovenian Krškopolje pig fed different diets and raised in different production systems (conventional and organic, indoor, outdoor). Also, a collection of data will be performed for multicriteria evaluation (productivity, welfare and environment) of Krškopolje pig in different production systems.

HIGH QUALITY PORK PRODUCTS WITH REGIONAL IDENTITY FROM BLACK SLAVONIAN, TUROPOLJE AND KRŠKOPOLJE BREED AND THEIR MARKET VALUE

Purchasing decisions of consumers are nowadays increasingly influenced by factors such as animal breed, housing conditions and overall animal welfare which results in niche pork products of different kinds. In this light one should not be surprised that British consumers rated animal welfare as the most important food issue, even above safety and health concerns (IGD, 2011; DEFRA, 2011). Regarding the significance of breed, Warriss et al. (1996) reported better eating quality of meat originating from traditional breeds; the difference was explained by higher levels of intramuscular fat in traditional breeds that are genetically fatter and have finer muscle grain. Furthermore, pigs raised on organic farms or in outdoors systems are expected, by the consumers with certain ethical attitudes, to be more nutritious, tasty, healthy and safe (Edwards, 2005). European label "Protected designation of origin" promotes the use of indigenous pig breeds kept in traditional outdoor or free-range systems, even though some PDO pork products are issued from conventional breeds.

The description of intrinsic quality of pork originating from Black Slavonian pigs using the toolbox for sensory, healthy, technological and typical qualities is basic step to be performed within the TREASURE project. Moreover, database on carcass and meat quality traits will be formed in the aim of development of breeding programme for this breed. Influence of housing system (outdoor vs. deep litter) on carcass composition and quality of traditional pork products from Crna Slavenska

pig breed will be examined with special emphasis on Slavonian kulen, product with national PGI label.

Similarly, different data with regard to carcass traits and quality of fresh and processed meat of Turopolje pigs will be collected according to the common quality indicators and related to animal diet and traditional feeding resources, such as acorn. Additionally, in line with current trends in traditional food sector (Vanhonacker et al., 2013), the acceptability and preference tests of health related innovations in traditional meat products will be conducted with local consumers in Zagreb metropolitan area using the prototypes of Turopolje pig meat products (e.g. products with healthier FA composition and/or less smoked products) and harmonised protocols for consumer sensory studies developed within the framework of TREASURE project.

In Slovenia, no specific product is associated with Krškopolje breed therefore carcass traits and quality of fresh and processed meat of Krškopolje pigs will be evaluated using a common toolbox developed in TREASURE. Also, Krškopolje breed shall be involved in building up the database on carcass and meat quality and breeding programmes adapted to local pig breeds. The products from Krškopolje breed will also be included in consumer preferences tests and studies on marketing strategies with local products.

CLOSING REMARKS

Due to the development of pig sector in the last century and expansion of modern genetically improved pig genotypes, many local pig breeds were abandoned. Biodiversity preservation is one of the main concerns of modern society. Preservation of small local breeds from extinction by direct payments from governments can help but is not sustainable therefore efforts should be made to make them sustainable through marketing. TREASURE aims to acquire the knowledge and build up the skills and competences necessary to develop existing and create new sustainable pork chains based on the European local pig breeds, in line with the highest consumer demands for quality and healthiness of pork products, and social demands regarding animal welfare, environment and rural development. The project will deal with 20 local pig breeds in 9 countries, among them also Black Slavonian, Turopolje and Krškopolje breed which shall be involved in activities addressing genetic characterization, performance of breeds in various production systems, their product quality and market value. Besides research, activities of knowledge transfer and networking of academia, professional and public sectors is expected to build up the capacities. One of the biggest challenges and ambitions of the project is to have an umbrella trademark of all the breeds and their products expected to increase their market recognition.

ACKNOWLEDGEMENT

TREASURE project is funded under European Union's Horizon 2020 research and innovation programme, grant no. 634476. The content of this presentation reflects only the authors' view and Research Executive Agency is not responsible for any use that may be made of the information it contains.

REFERENCES

1. Budimir, K., Margeta V., Kralik, G., Margeta, P. (2013): Silvo-pastoralni način držanja crne slavonske svinje. *Krmiva*, 55(3): 151-157.
2. DEFRA, 2011, Attitudes and Behaviours around Sustainable Food Purchasing, Report SERP 1011/10, Home page address: <http://www.defra.gov.uk/statistics/foodfarm/food/> (accessed 15.05.2015)
3. Edwards, S.A. (2005): Product quality attributes associated with outdoor pig production. *Livestock Production Science*, 94: 5-14. doi: <http://dx.doi.org/10.1016/j.livprodsci.2004.11.028>
4. Eurostat (2014): http://ec.europa.eu/eurostat/statistics-explained/index.php/Pig_farming_sector_-_statistical_portrait_2014 (accessed 20.04.2015)
5. Eurostat regional yearbook (2014): <http://ec.europa.eu/eurostat/documents/3217494/5786409/KS-HA-14-001-11-EN.PDF> (accessed 20.04.2015)
6. IGD (2011): Shopper Attitudes to Animal welfare A Report for Freedom Food by IGD, http://www.freedomfoodpublishing.co.uk/fairerlife/downloads/Shopper_Attitudes_Animal_Welfare_Report.pdf (accessed 07/12/11)
7. Kongsro, J. (2014): Genetic gain on body composition in pigs by Computed Tomography (CT): Return on investment. *Farm Animal Imaging III*. Eds. C. Maltin, C. Craigie and L. Bunger. Copenhagen, Denmark. pp 28.
8. Kralik, G., Margeta, V., Gajčević, Z., Hanžek, D. (2005): Komparativni prikaz tovnih i klaoničkih obilježja svinja utovljenih na dubokoj stelji i na konvencionalan način. *Krmiva*, 47(4): 179-187.
9. Kühne, B., Vanhonacker, F., Gellynck, X., Verbeke, W. (2010): Innovation in traditional food products in Europe: Do sector innovation activities match consumers' acceptance? *Food Quality and Preference*, 21: 629-638. doi: <http://dx.doi.org/10.1016/j.foodqual.2010.03.013>
10. Kušec, G., Baulain, U., Kallweit, E., Glodek P. (2007a): Influence of MHS genotype and feeding regime on allometric and temporal growth of pigs assessed by magnetic resonance imaging. *Livestock Science*, 110(1-2): 89-100.
11. doi: Kušec, G., Baulain, U., Kallweit, E., Glodek P. (2007a): Influence of MHS genotype and feeding regime on allometric and temporal growth of pigs assessed by magnetic resonance imaging. *Livestock Science*, 110(1-2): 89-100. doi: <http://dx.doi.org/10.1016/j.livsci.2006.10.007>
12. Kušec, G., Kralik, G., Đurkin, I., Baulain, U., Kallweit, E. (2007b): Optimal slaughter weight of pigs assessed by means of asymmetric S-curve. *Czech Journal of Animal Science*, 53(3): 98-105.

13. Margeta, V., Kralik, G., Škrtić, Z., Hanžek, D. (2005): Mikroklimatski uvjeti i proizvodnost svinja u različitim uvjetima tova. *Agriculture*, 11(2): 55-61.
14. Marquer, P., Rabade, T., Forti, R. (2014): Statistics in focus 15/2014 ISSN: 2314-9647 Catalogue number: KS-SF-14-015-EN-N (online version: http://ec.europa.eu/eurostat/statistics-explained/index.php/Pig_farming_sector_-_statistical_portrait_2014) (accessed 16.03.2015)
15. Salajpal, K., Karolyi, D., Luković, Z. (2013): Sanitary aspects of outdoor farming systems. *Acta agriculturae Slovenica*, Supplement 4: 109-117.
16. Vanhonacker, F., Kühne, B., Gellynck, X., Guerrero, L., Hersleth, M., Verbeke, W. (2013): Innovations in traditional foods: Impact on perceived traditional character and consumer acceptance. *Food Research International*, 54: 1828-1835.
doi: <http://dx.doi.org/10.1016/j.foodres.2013.10.027>
17. Verriera, E., Tixier-Boicharda, M., Bernigauda, R., Navesa, M. (2005): Conservation and value of local livestock breeds: usefulness of niche products and/or adaptation to specific environments. *Animal Genetic Resources Information*, 36: 21-31.
doi: <http://dx.doi.org/10.1017/S1014233900005538>
18. Vincek, D., Sabo, K., Kušec, G., Kralik, G., Đurkin, I., Scitovski, R. (2012): Modeling of pig growth by S-function – least absolute deviation approach for parameter estimation. *Archiv Tierzucht*, 55(4): 364-374.
19. Warriss, P.D., Kestin, S.C., Brown, S.N., Nute, G.R. (1996): The quality of pork from traditional pig breeds. *Meat Focus Int.*, May–June, 179-182.

(Received on 15 June; accepted on 28 July 2015)