



## Possibilities of branding the pork in Croatia – review

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### **ABSTRACT**

*Black Slavonian pig is an indigenous pig breed black in colour, resistant and convenient for keeping in extensive conditions. It is also characterized by good meat quality, suitable for typical traditional meat products. Traditionally produced food came into the focus which led to more often use of geographical indications as the valuable rural development strategy. Since Black Slavonian pig is a late maturing breed with low lean meat content, meat processors often use the meat of modern pig breeds in the production of traditional products. Molecular identification of breed is a good tool for authentication of meat. Since age and sex are among the most significant sources of variation of the carcass and meat quality traits in pigs, the research on the optimal time for slaughter with respect to these factors could increase the profitability of pork production. The genetic influence on meat quality traits is nowadays well described by the use of molecular markers and candidate genes such as IGF2, MC4R, H-FABP3 and LEPR; their frequencies could be of assistance in the description of Black Slavonian pig and its exceptional meat quality traits. The investigation of sensory characteristics and chemical analysis of meat and meat products is needed to determine the typical physicochemical characteristics and sensory profile of pork originated from Black Slavonian Pig which is a firm base for branding. Finally, DNA characterisation of the breed can be used as the tool for authentication of pork in the aim of preventing possible adulterations of autochthonous meat products.*

(Keywords: Black Slavonian pig, traditional meat products, intramuscular fat content, molecular markers)

### **INTRODUCTION**

Black Slavonian pig is a pig breed established at the end of the 19th century near Osijek in eastern Croatia. This pig had excellent characteristics for that time, as confirmed by a gold medal won at Vienna World Exposition in 1873. The breed is black in color, resistant and convenient for keeping in extensive (pastures, woods) and half-extensive conditions (pens with some free space). A population size began to decline due to the appearance of modern breeds, superior in lean meat content and better reproductive ability. Although Black Slavonian pig has low productivity, it is also characterized by good meat quality, suitable for producing typical traditional meat products such as “kulen” (dry cured sausage spiced with red paprika), ham, bacon and other meat products. In recent years, the traditionally produced food came into the focus which led to more often use of geographical indications as the valuable rural development strategy. Geographical indication are defined in current EU legislation as protected designation of

origin (PDO), protected geographical indication (PGI) and Traditional Specialties Guaranteed (TSG). These can be a powerful tool in branding of the meat product but also fresh meat.

The objective of this paper is to discuss various scientific approaches which could help in the creation of new brand among the animal products in Croatia.

## **MOLECULAR IDENTIFICATION**

The first criteria and the simplest one to distinguish Black Slavonian pigs from other breeds is coat color. However, phenotypic distinguishing between purebred and F1 crossbred pigs is not possible because of dominant black color of Black Slavonian pig (Margeta *et al.*, 2009). *Extension (E)* is one of the coat color loci, which encodes the melanocortin receptor 1 (MC1R) expressed in melanocytes. *Extension/MC1R* is also one of the major coat color loci in pigs and a series of alleles with phenotypic effects has been revealed by sequence analysis (Kijas *et al.*, 2001; Giuffra *et al.*, 2000). Wild boars possess wild-type alleles; *MC1R\*1* (European) or *MC1R\*5* (Japanese wild boar). Two different alleles for dominant black color were detected. Large Black and Meishan pigs carry *MC1R\*2*, while Hampshire possesses *MC1R\*3*. The recessive red coat color of swine is characteristic for Duroc and is associated with *MC1R\*4*. The sixth allele, *MC1R\*6* was determined in Yorkshire, Landrace and black-spotted pig breeds (Kijas *et al.*, 2001). This approach may be not sufficient to differentiate Black Slavonian pig from other black coated breeds. However, the development of DNA based markers in the last two decades has revolutionized the possibilities to monitor genetic diversity of populations by making it feasible to screen large numbers in a relatively short time. One type of marker that has been intensely used for population studies in the last 10 years, are the so-called microsatellite or single sequence repeat markers (Martínez *et al.*, 2000; Laval *et al.*, 2000). In the pig, numerous studies of genetic variation between or within different pig breeds were conducted by genotyping multiple microsatellite loci (Li *et al.*, 2004, Fang *et al.*, 2005; Swart *et al.*, 2010). Recent studies have included SNP analysis in the traditional pig breed-labelled products Wilkinson *et al.* (2012), but also for fatty acid composition (Revilla *et al.*, 2014), intramuscular fatty acid composition (Ramayo-Caldas *et al.*, 2014), growth in purebred population (Stratz *et al.*, 2014; Yung *et al.*, 2014) etc.

## **INVESTIGATIONS OF GROWTH**

Growth is one of the main physiological activities in all of domestic animals, but it has a special significance in the case of animals oriented at meat production such as pigs, beef, sheep, poultry etc. Traditionally, the changes of body composition during growth are studied using the methods such as dissection of the carcass, CT, MRI and some other useful techniques at varying age or body weight (Giles *et al.*, 2009). It is a complex problem, especially when it comes to a modelling of the growth patterns. If some of the dynamic, non-linear functions are selected for modelling, it is important to correctly determine the upper limit of growth, i.e. biological maximum (A) growth of an animal, mature weight or a maximum weight in the point of interest. This parameter is the measure of animal's growth capacity or potential, which is one of the determinants for the prediction of the weight of an animal in given conditions (Wellock *et al.*, 2003). Kuhn *et al.* (1985) used the Gompertz function, while López *et al.* (2000) used Gompertz, Richard's and the generalised Michaelis-Menten function to describe the

growth of several species. On the other hand, *Kušec et al.* (2008) showed that asymmetric S-function can be used as a tool in the prediction of live weight, muscle and fat growth of pigs not only within the interval of measurement but throughout the whole time scale. Since it is very well known that carcass composition and meat quality traits are significantly influenced by age, growth studies can improve the profitability in pig production; for example by prediction of optimal slaughter weight/age which is especially important in case of heavy pigs aimed at the production of traditional meat products.

## INVESTIGATION OF CANDIDATE GENES

The genetic influence on meat quality traits is nowadays well described by the use of molecular markers by which many of the candidate genes were discovered. There are several interesting candidate genes such as MC4R, IGF2, H-FABP3 and LEPR.

### MC4R

This gene plays a major role in the regulation of food intake and regulation of energy balance. Targeted alteration (mutation) of MC4 receptor evidently causes increased food intake. Porcine MC4R locus is mapped on the 1st chromosome (SSC1 q22-q27) and Asp298Asn missense mutation is identified (*Kim et al.*, 2000). This mutation is associated with pigs that grow faster and have greater fat thickness, and its effect by the number of days required to reach slaughtering weight of 110 kg, daily gain and daily food intake in different commercial pig breeds (*Hernandez-Sanchez et al.*, 2004). *Piorkowska et al.* (2009) were exploring the effect of MC4R gene on carcass composition, growth and meat quality traits of 1191 gilts originating from five different breeds. The authors found that G allele is common in breeds selected for leanness (Pietren 92.4%), and rare in breeds with the higher percentage of intramuscular fat (Duroc 31.5%). *Carrodeguas et al.* (2005) and *Burgos et al.* (2006) designed the RT-PCR analysis to explore the possibility of using MC4R and IGF2 as a selection marker that would allow the prediction of fattening capacity of Iberian pigs and Duroc, breeds used for producing hams protected by designation of origin (*Ovilo et al.*, 2006; *Schwab et al.*, 2009).

### IGF-2

IGF2 (somatomedin A, insulin-like growth factor 2) is a member of insulin family of the /IGF/ relaxin growth factors which possess activity to improve tissue growth. Single nucleotide polymorphism (G to A transition) was observed in exon 2 of this gene and microsatellite (SW9) located 800bp lower than IGF2 stop codon is mapped using linkage analysis (*Nezer et al.*, 1999). Quantitative Trait Locus (QTL), which is inherited and expressed only from the paternal allele, thereby impacting on muscle mass, accumulation of fat and the heart girth, is mapped close to IGF2 gene (*Knoll et al.*, 1999). Substitution of IGF2-intron3-G3072A, localized in a highly conserved regulatory region, is causing mutation of this QTL.

### H-FABP3

Studies were conducted which detected candidate genes that have an impact on the content of intramuscular fat content in pig carcasses: intracellular cardiac fatty acid-binding protein, H-FABP (*Li et al.*, 2010.), ccyl coenzyme A diacylglycerol acyltransferase (DGAT-1), sterol binding protein 1c (SREBP-1c) (*Chen et al.*, 2008),

leptin receptor. Determined percentage of intramuscular fat content in some commercial pig breeds is less than 1.5%, but the assumption is that the proportion of IMF in Black Slavonian breed ranges between 6% and more. FABP3 gene can be used as a genetic marker in the selection for the intramuscular fat content. *Tyra et al.* (2013) reported that 30 % to 35% of the IMF variation in the study populations consequence of FABP3 gene polymorphism. Research conducted by *Gerbens et al.* (2001) and *Zhao et al.* (2012) confirmed the association of polymorphisms of genes FABP3 content and intramuscular fat.

### **LEPR**

LEPR gene is mapped on chromosome 6 and it has a known effect on fattening traits and control of food consumption in pigs. Leptin is a protein whose activity is mediated through the leptin receptor gene and LEPR gene that is considered as the candidate gene for growth traits. *Muñoz et al.* (2011) state the connection of the not synonymic mutations p.Leu663Phe with consumption of the foods and consequently, with the formation of adipose tissue.

## **INVESTIGATION OF SENSORY TRAITS AND CHEMICAL ANALYSIS OF MEAT AND MEAT PRODUCTS**

The indigenous Slavonian dry-cured meat products obtained from meat of Black Slavonian Pig are highly recognized and most appreciated by consumers in Croatia due to specific sensory profile that originates from the meat of these pigs. Genetic background of the pigs and their traditional outdoor feeding on natural resources such as grass and forest of Slavonian oak (*Quercus robur L.*) with addition of small amount of corn or other grains (*Karolyi et al.*, 2010) are probably responsible for generation of the specific extraordinary sensory features of the autochthonic Slavonian kulen and other Slavonian traditional dry-cured meat products. Due to activity of the specific endogenous enzyme system (proteolytic and lipolytic; *Cava et al.*, 2004), and the oxidative phenomena (*Gandemer*, 2002) during processing of dry-cured meat products, important degradative changes in proteins and lipids take place. Some authors have found differences in proteolytic and lipolytic activities as a consequence of genetic background (*Cava et al.*, 2004) and some also have found these differences as a consequence of free-range rearing of pigs (*Daza et al.*, 2005; *Muriel et al.*, 2002). These differences lead to the formation of specific volatile and non-volatile compounds; many of them have a decisive influence on the creation of the specific aroma and flavour of the meat products.

## **CONCLUSIONS**

Black Slavonian pig is pig breed with desirable meat quality and gives an excellent material for added value high quality products-true Croatian brands. First step in the process of branding pork is genetic description of breed, in our case Black Slavonian pig. Further investigations on growth can improve the profitability of pork production by setting the correct time for slaughter. Full description of sensory traits with the possibility of differentiation of pork originating from Black Slavonian from other, commercial breeds are also crucial in the process of branding. Finally, DNA characterisation of the breed should be used as the tool for authentication of pork in the aim of preventing possible adulterations of autochthonous meat products.

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