

THE QUALITY OF TRADITIONALLY SMOKED TENDERLOINS OBTAINED FROM MEAT OF NATIVE PIG BREEDS

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Original scientific paper

Abstract: The domestic (homeland, native) populations - breeds of pigs are grown in certain region and/or country as local, primitive breeds. In Poland following 3 pig breeds are considered as native: Pulawska, Zlotnicka White and Zlotnicka Spotted. The aim of this study was the assessment of the quality of meat and traditionally smoked tenderloins obtained from meat of native pigs breeds bred in a traditional way. Meat analysis showed that the highest fat content values were present in Zlotnicka Spotted (4.60 ± 0.33) and White (3.63 ± 0.41) while the lowest in Pulawska (2.78 ± 0.29). Smoked tenderloins shear force differed statistically. The hardness values were the highest for Zlotnicka White (65.66 ± 6.46) and the lowest for Zlotnicka Spotted (33.27 ± 4.12). Similar shear force values were recorded: the highest in Zlotnicka White (51.90 ± 7.11) and the lowest in Zlotnicka Spotted (30.43 ± 5.54). Regardless of the results obtained, meat products have good acceptance of sensory assessment test and low level of polycyclic aromatic hydrocarbons. We conclude that the meat of Pulawska, Zlotnicka White and Spotted breeds of pigs is a good quality raw material used for production of traditional and regional meat products gaining high sensory scores and good recognition among consumers. The traditionally smoked tenderloins produced from meats of above breeds, were characterized by very good quality parameters.

Key words: fatteners, native breeds, meat, tenderloins, quality

Introduction

The farm animals have accompanied humans more than 10 thousand years. Over the centuries, man has created about 8 thousand animal breeds. In the FAO database, 7,616 breeds are registered, of which over 85% are so-called local breeds (Litwińczuk, 2017). They have given not only food but also helped with farmer field work, were the components of agri-landscape playing the immanent part of nature, of culture and even ethnography. Nowadays, according to data obtained for 2016 in Poland, the altogether number of registered and preserved with *in situ* programs, is 83 breeds, varieties and lines, where 43 are mammals, 35 domestic birds and 5 bees lines. They are bred on 3259 farms (Krupiński et al., 2017).

The native populations breeds of pigs are grown in the certain region and/or country as local, primitive breeds, for example, Mangalitsa, Moravka, Resavka, Iberian, Casertana, Alentejana, Bazna, Mora Romagnola, Krskopolje, Turopolje (Čandek-Potokar, 2019; Popova et al., 2015; Pugliese and Sirtori, 2012; Radović et al., 2017; Radović et al., 2019). These breeds are characterized by lower fattening, slaughter and breeding yield parameters but their advantages are good quality raw meat, lower feeding demands, natural resistance to bad environmental conditions and higher resistance against illnesses and stress in comparison to regular industrial breeds (Čandek-Potokar, 2019; Pugliese and Sirtori, 2012; Radović et al., 2019). In Poland following 3 breeds are included in the group of native breeds: Pulawska, Zlotnicka White and Zlotnicka Spotted pig breeds (Szyndler-Nędza et al., 2011). The breeds are outstanding for high reproduction traits and well survival ability in difficult environmental conditions (Litwińczuk, 2017). Also they are known for good maternal traits (Szyndler-Nędza et al., 2011). The pigs of Polish homeland breeds can be used for breeding of heavy fatteners, because even after obtaining high body weight the meat shows very good quality (Babicz et al., 2009; Martyniuk, 2010; Szyndler-Nędza, 2012). The asset of meat of these breeds is advantageous muscle fibrils structure and the amount of intramuscular fat favourably influencing the meat marbling and sensory properties. Thanks to above the meat of these pigs breeds is used for production of regional meat products (Hammermeister and Blicharski, 2007; Szyndler-Nędza et al., 2011).

The aim of the study was the assessment of quality of meat and traditionally smoked tenderloins obtained from meat of native pigs breeds bred in a traditional way.

Material and Methods

Tenderloins

In scope of the project “The uses and the conservation of farm animal genetic resources under sustainable development” co-financed by the National

Centre for Research and Development within the framework of the strategic R&D programme “Environment, agriculture and forestry” – BIOSTRATEG, contract number: BIOSTRATEG2/297267/14/NCBR/2016 meat products of native Polish pig breeds were analysed.

The experimental material were 18 traditionally smoked tenderloins prepared using the *m. longissimus dorsi*, bought in factories processing meats of native pig breeds (Pulawska, Zlotnicka Spotted and White) – 6 items of each native pig breed. The recipes of smoked loins production were reserved by meat factories. But general technological scheme of production was stated as (according to producer’s statements):

- Choice of raw material – loin
- Brining (multi-needle injection of brine)
- Massage (cylindrical shape rotating massage apparatus; 3 hours in vacuum with 6 rotations per 1hour)
- Deposition and ageing (drying of surface, colour adjustment; smoking trolley; 1 hour)
- Smoking (traditional smoking chamber; beech-alder woodchips; to obtain internal bar temp. of 72°C)
- Chilling and cooling (to product temp. below 10°C).

The obtained samples of meat were subjected to physical-chemical analyses.

Tenderloins quality

The tenderloins were minced and average samples obtained were subjected to chemical analyses.

The following items were estimated in the tenderloins samples:

- water content according to the standard (*PN-ISO 1442:2000*),
- fat content according to the standard (*PN-ISO 1444:2000*),
- protein content by Kjeldahl method (*PN-75/A-04018*),
- total ash content according to the standard (*PN-ISO 936:2000*),
- total carbohydrates content was calculated assuming that the all total solids and water stand for 100%,

- The measurements of colour of meat and tenderloins samples were obtained in CIELab system. Lightness [L*], redness [a*] and yellowness [b*] of meat were determined using a Konica Minolta CM-600d spectrophotometer,
- polycyclic aromatic hydrocarbons (PAHs) (benzo(a)pyrene and sum of benzo(a)pyrene, benzo(a)anthracene, benzo(b)fluorantene and chrysene) according to the HRGC-HRMS method (CZ_SOP_D06_06_180 - except chap. 11.3.3.1 - 11.3.3.7, 11.3.3.9 1, 11.3.4 (US EPA 429, ISO 11338); PAH16: Determination of polyaromatic hydrocarbons by isotope dilution method using HRGC-HRMS),
- Texture profile analysis (TPA) of smoked loin was performed with TA-XT2 Stable Microsystem texturometer. There were obtained texture profile parameters: hardness, springiness, cohesiveness, chewiness and resilience with double pressing test of 10 samples (15 mm high and 15 mm diameter) of each meat and loin lot. The samples were squeezed up to 50% of their height. The test speed of 50mm cylindrical probe was 1,5mm with 3 s pause between squeezes. The measurement of shear force was performed with Warner-Bratzler triangle edge knife. From each lot were cut out 5 cylindrical samples (diameter 15mm, height 15mm) and the force needed for rectangular samples cutting was measured. The test blade speed was 2 mm/s.
- There was also performed consumer sensory analysis. There were assessed 9 quality characteristics with 5 point hedonic scale (PN-ISO 6658. 1998). The assessment was made by the 10-person panel consisting of employees of the Department of Animal Product Technology, University of Agriculture in Krakow. The panel had years of experience in sensory evaluation practice and were trained theoretically and practically for the methods applied (ISO 8586: 2014).

Statistical analysis

All samples were obtained at least in duplicates. All results were analysed with ANOVA and present as means with standard deviation. The calculations were performed with Statistica 6.0 (*StatSoft, 2003*).

Results and Discussion

In Table 1 the chemical composition and colour of traditionally smoked tenderloins bought in factories processing meat of native pig breeds (Pulawska, Zlotnicka Spotted and White) is presented. The traditionally smoked tenderloin obtained from Pulawska fatteners' meat was characterised by statistically significant lower fat content in comparison to tenderloins produced from Zlotnicka White and Spotted fatteners' meat. Admittedly the high intermuscular fat content influences negatively the assessment of meat by consumers, but the fat determines the taste and texture meat traits. The level of intermuscular fat especially determines the quality of raw ripened and raw smoked hams (*Szulc and Skrzypczak, 2016*). The traditional smoked tenderloins obtained from Zlotnicka breeds were the raw ripened smoked products so their higher fat content was influencing positively their quality. *Wood et al. (1999)*, *Daszkiewicz et al. (2005)* and *Tyra and Mitka (2015)* revealed that the optimal taste, tenderness and juiciness is observed in meat containing 2.5 – 3.0 % of fat. The contents of proteins and ash were also higher in tenderloins obtained from Zlotnicka breeds meat in comparison to Pulawska breed.

Table 1. Chemical composition and colour of traditionally smoked tenderloins obtained of Pulawska, Zlotnicka White and Zlotnicka Spotted fatteners (mean±SD)

| Chemical component [%] | Breed of fatteners | | |
|------------------------|---------------------------|---------------------------|---------------------------|
| | Pulawska | Zlotnicka White | Zlotnicka Spotted |
| Water | 68.84 ± 3.84 | 64.91 ± 2.79 | 63.90 ± 3.06 |
| Protein | 26.31 ^a ± 1.82 | 28.12 ^b ± 1.61 | 28.90 ^b ± 1.49 |
| Fat | 2.78 ^a ± 0.29 | 3.63 ^{ab} ± 0.41 | 4.60 ^b ± 0.33 |
| Ash | 1.89 ^a ± 0.08 | 3.13 ^b ± 0.10 | 2.47 ^a ± 0.08 |
| Carbohydrates | 0.18 ^a ± 0.008 | 0.21 ^a ± 0.01 | 0.13 ^b ± 0.009 |
| Colour | | | |
| L* | 56.73 ^a ± 4.71 | 48.01 ^b ± 3.91 | 50.51 ^b ± 5.12 |
| a* | 7.79 ± 1.77 | 8.99 ± 1.85 | 8.76 ± 1.73 |
| b* | 8.65 ^a ± 1.57 | 5.84 ^b ± 1.16 | 5.02 ^b ± 1.62 |

^{a,b} Mean values in rows marked with a different letters differ statistically significantly at $P \leq 0.05$

Janiszewski et al. (2015) assessed smoked loins and cooked hams produced using meat of Zlotnicka Spotted pigs and of crossbreds of that breed with Duroc and PLW (Polish Large White). The quality of meat smoked products obtained from assessed fatterer groups did not differ significantly in regard to the physicochemical and sensory parameters. The assessed products differed in chemical composition because the loins lowest in fat were obtained from crossbred fatteners: (Zlotnicka Spotted x Polish Large White - ZSxPLW), whereas the hams lowest in fat were obtained from purebred fatteners. *Kędzior et al. (2014)* revealed that the

traditional products have a higher nutritional value than conventional ones. They contain significantly more protein, less water and salt, and thus less total ash. Table 2 contains the content of polycyclic aromatic hydrocarbons in traditional tenderloins.

The tenderloins obtained from Pulawska pigs were characterized by higher values of parameter b^* (yellow). According to *Szulc and Skrzypczak (2015)* the meat of native pig breeds is characterized by darker colour which is preferred nowadays by a part of consumers. The dark colour of meat is characteristic both for European wild boar and other European native pig breeds (*Szulc and Skrzypczak, 2015*).

Table 2. Content of polycyclic aromatic hydrocarbons in traditional tenderloins ($\mu\text{g}/\text{kg}$)

| Polycyclic aromatic hydrocarbons | Traditional tenderloins of native pigs breeds: | | |
|----------------------------------|--|-----------------|-------------------|
| | Pulawska | Zlotnicka White | Zlotnicka Spotted |
| Naphtalene | 24.0 \pm 7.20 | 21.0 \pm 6.30 | 51.0 \pm 15.3 |
| Acenaphthylene | 35.0 \pm 10.5 | 27.0 \pm 8.10 | 21.0 \pm 6.30 |
| Acenaphthene | 1.20 \pm 0.36 | 3.10 \pm 0.93 | 2.90 \pm 0.87 |
| Fluorene | 11.0 \pm 3.30 | 20.0 \pm 6.00 | 1.30 \pm 0.39 |
| Phenanthrene | 52.0 \pm 15.6 | 60.0 \pm 18.0 | 47.0 \pm 14.1 |
| Anthracene | 7.40 \pm 2.20 | 15.0 \pm 4.50 | 10.0 \pm 3.00 |
| Fluoranthene | 16.0 \pm 4.80 | 13.0 \pm 3.90 | 7.70 \pm 2.31 |
| Pyrene | 13.0 \pm 3.90 | 12.0 \pm 3.60 | 6.90 \pm 2.07 |
| Benzo(a)anthracene | 1.30 \pm 0.39 | <0.90 | <0.87 |
| Chrysene | 1.10 \pm 0.33 | <0.90 | <0.87 |
| Benzo(b)fluoranthene | <0.81 | <0.31 | <0.43 |
| Benzo(k)fluoranthene | <0.54 | <0.31 | <0.43 |
| Benzo(a)pyrene | <0.54 | <0.31 | <0.65 |
| Indeno(1,2,3-cd)pyrene | <0.75 | <0.31 | <0.43 |
| Dibenzo(a,h)anthracene | <0.30 | <0.21 | <0.23 |
| Benzo(g,h,i)perylene | <0.59 | <0.34 | <0.43 |

The analysed tenderloins were safe as contents of polycyclic aromatic hydrocarbons. The loins obtained of Pulawska breed meat contained larger amounts of benzo(a)anthracene and chrysene in comparison to loins obtained from Zlotnicka breed pig. All tenderloins fulfilled the demands listed in EC *Commission Regulation no 835/2011 (Migdał et al., 2015)*. The results have revealed that traditionally smoked products have high quality and safety, especially as PAHs contents which could result from smoking using the traditional methods. In Table 3 the texture profile and the shear force of analysed tenderloins are presented, whereas in Table 4 the results of consumers' assessment.

Table 3. Texture profile and shear force for traditionally smoked tenderloins obtained from fatteners of Pulawska, Zlotnicka White and Spotted breeds

| Breed of fatteners | Texture profile | | | | | Shear force [N] |
|--------------------|-----------------------------|----------------|----------------|-----------------------------|-----------------|-----------------------------|
| | Hardness [N] | Springiness | Cohesiveness | Chewiness [N] | Resilience | |
| Pulawska | 45.59 ^a ±5.84 | 0.457 ±0.06 | 0.272 ±0.04 | 5.66 ^a ±0.62 | 0.125 ±0.02 | 34.99 ^a ±6.04 |
| Zlotnicka White | 65.66 ^b ±6.46 | 0.36 ±0.04 | 0.339 ±0.04 | 8.01 ^b ±0.74 | 0.121 ±0.02 | 51.90 ^b ±7.11 |
| Zlotnicka Spotted | 33.27 ^a ±4.12 | 0.438 ±0.05 | 0.367 ±0.05 | 5.346 ^a ±0.60 | 0.125 ±0.018 | 30.43 ^a ±5.54 |

^{a,b} Mean values in columns marked with a different letters differ statistically significantly at $p \leq 0.05$

The tenderloins produced from Zlotnicka Spotted breed meat were characterized by better hardness and shear force parameters and in consumer assessment obtained the highest total score. *Grześkowiak et al. (2007)* when analysing the raw smoked loins obtained from Zlotnicka breeds pigs meat observed higher values of shear force – for Zlotnicka White: 58.23 (N) and for Zlotnicka Spotted: 45.71 (N).

Table 4. The quality characteristics and average scores for consumer assessment of traditionally smoked tenderloin of Pulawska, Zlotnicka White and Spotted fatteners

| Quality characteristics | Fattener breeds | | | |
|-------------------------|-----------------|-------------------|-------------------|-------------------|
| | Pulawska | Zlotnicka White | Zlotnicka Spotted | |
| Appearance | 4.80 ± 0.17 | 4.70 ± 0.15 | 4.80 ± 0.15 | |
| Slice cut colour | 4.60 ± 0.19 | 4.60 ± 0.15 | 4.70 ± 0.12 | |
| Slice structure | 4.70 ± 0.20 | 4.60 ± 0.15 | 4.80 ± 0.15 | |
| Slice cohesiveness | 4.80 ± 0.12 | 4.75 ± 0.20 | 4.80 ± 0.15 | |
| Odour | Intensity | 4.90 ± 0.11 | 4.65 ± 0.15 | 4.90 ± 0.12 |
| | Desirability | 4.80 ± 0.12 | 4.60 ± 0.15 | 4.80 ± 0.12 |
| Tenderness | 4.75 ± 0.14 | 4.50 ± 0.18 | 4.80 ± 0.15 | |
| Juiciness | 4.70 ± 0.13 | 4.80 ± 0.17 | 4.80 ± 0.12 | |
| Saltiness | 4.60 ± 0.16 | 4.00 ± 0.15 | 4.60 ± 0.15 | |
| Taste | Intensity | 4.75 ± 0.17 | 4.60 ± 0.11 | 4.80 ± 0.12 |
| | Desirability | 4.80 ± 0.15 | 4.80 ± 0.12 | 4.90 ± 0.11 |
| Total score | | 4.75 ± 0.11 | 4.64 ± 0.10 | 4.815 ± 0.11 |
| | | Very good quality | Very good quality | Very good quality |

The consumer panel estimated higher the traditionally smoked tenderloin obtained from Zlotnicka Spotted fatteners than loins produced from Zlotnicka White and Pulawska breeds. The loins produced of Zlotnicka Spotted pigs obtained higher scores for odour/aroma, tenderness, juiciness and flavour – the characteristics directly related to the content of intermuscular fat. In the work of *Szulc et al. (2011)* slightly higher scores are obtained for raw, smoked loin produced from Zlotnicka White breed meat in comparison to Zlotnicka Spotted breed meat. To obtain the optimum sensory quality the authors list different amounts of intramuscular fat. *Łyczyński et al. (2007)* revealed as the most favourable amount of intramuscular fat the levels 2-3 %, whereas *Wood et al. (1999)* the levels from 2.0 to 3.5 %. *Olkiewicz et al. (2006)* as most favourable have chosen the level of at about 3 %. In our experiment, the loins obtained from Zlotnicka Spotted breed meat contained 4.60 % of intermuscular fat, the loins obtained from Zlotnicka White contained 3.63 % and the loins produced of Pulawska breed pigs contained 2.78 %, respectively, on average. *Florowski et al. (2006)* described that the fatteners' breed is the factor which significantly influences and differs many of meat quality characteristics. Among all pig breeds kept in Poland, the advantageous characteristics are observed with Duroc breed, the native breeds, here also good scores for Pulawska breed, whereas lower scores are granted to Pietrain breed meat. Paralely with growth of fatness of fatteners the losses during preservation and preparation for consumption of meat are also growing (*Trombetta et al., 1997*). The intermuscular fat content above 2.5 % can influence the lower score of meat granted by consumers because of meat marbling (*Czarniecka-Skubina et al., 2007*). But on the other side, the higher intermuscular fat content of the traditionally smoked tenderloins produced using such meat have better scores for aroma, tenderness, juiciness and flavour/taste.

Above described characteristics are observed in meat of all estimated, native pig breeds - Pulawska, Zlotnicka White and Zlotnicka Spotted. The meat of these fatteners is widely used for production of traditional products high in demand by consumers, so they have to be bred and preserved. The practical protection rules of each native breed depend directly from each breed market position i.e. the quality of raw slaughter material, the traditional and regional products possible to obtain and of the promo-marketing activities. For above reason there is lead a campaign "Wieprzowina regionalna – doceń smak tradycji" (regional pork meat-appreciate the taste of tradition).

The fatteners of native breeds, despite of lower content of meat in the carcass, are characterized by a high meat quality with the proper meat myofibrils structure, good marbling and very good sensory characteristics. These assets of native breed meats cause that they are the basic raw material for regional meat products (*Hammermeister and Blicharski, 2007; Szyndler – Nędza et al., 2011*). The meat of Zlotnicka Spotted breed is especially suited for production of long ripened meat products (*Szyndler-Nędza et al., 2012; Sulc et al., 2012*).

According to *Kušec et al. (2015)* protection of small local breeds from extinction through direct payments from governments may help, but it is not sustainable, so efforts should be made sustainable by marketing.

Conclusions

The meat of Pulawska, Zlotnicka White and Spotted breeds of pigs is a good quality raw material which is used for production of traditional and regional meat products gaining high sensory scores and good recognition among consumers. The meat of Zlotnicka Spotted breed deserves the special attention because of advantages intramuscular fat content, lower thermal losses and smaller shear force.

The pigs of Pulawska, Zlotnicka White and Spotted belong to native preserved breeds. Even though these breeds are characterized by lower parameters of fattening and slaughter yields, their asset is a good quality raw material used for traditional and regional meat products gaining the recognition from consumers. The traditionally smoked tenderloins produced using the meat of above mentioned breeds, are characterized by very good quality parameters. The analysed smoked loins were safe due to the low content of polycyclic aromatic hydrocarbons. The consumer panel assessed as the best the tenderloin produced from Zlotnicka Spotted pig meat. The high scores granted by consumers to tenderloins obtained from native pig breeds hold the good promise for their future. Promotion of traditional products obtained from above assessed breeds will favour the development of their breeding and stocks rising.

Kvalitet tradicionalno dimljene pečenice dobijenih od mesa autohtonih rasa svinja

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Rezime

Domaća (nativna) populacija - rase svinja su rase nastale u određenom regionu i/ ili zemlji kao lokalne, primitivne rase. U Poljskoj to su 3 rase svinja: pulavska, zlotnička bela i zlotnička šarena svinja. Cilj rada bio je procena kvaliteta mesa i tradicionalno dimljenih pečenica dobijenih od mesa autohtonih rasa svinja koje se uzgajaju na tradicionalan način. Analiza mesa pokazala je da je najveći udeo masti u zlotničkoj šarenoj svinji ($4,60 \pm 0,33$) i beloju ($3,63 \pm 0,41$), dok je najmanji u

pulavskoj ($2,78 \pm 0,29$). Vrednosti dobijene za silu presecanja dimljene pečenice se statistički razlikuju. Vrednosti tvrdoće bile su najviše kod zlotničke bele ($65,66 \pm 6,46$), dok su najniže bile kod zlotničke šarene ($33,27 \pm 4,12$). Slične vrednosti sile presecanja utvrđene su kod zlotničke bele ($51,90 \pm 7,11$), odnosno kod zlotničke šarene rase ($30,43 \pm 5,54$). Bez obzira na dobijene rezultate, mesni proizvodi su dobili dobre ocene na testu senzorne procene i nizak nivo policikličkih aromatskih ugljovodonika. Zaključujemo da je meso pulavske, zlotničke bele i šarene rase svinja kvalitetna sirovina koje se može koristiti za proizvodnju tradicionalnih i regionalnih mesnih proizvoda čime se postižu visoki senzorni rezultati i dobro prepoznaju kod potrošača. Tradicionalno dimljene pečenice proizvedene od mesa navedenih rasa odlikuju su vrlo kvalitetnim parametrima.

Ključne reči: tovljenici, autohtone rase, meso, žitarice, kvalitet

Acknowledgements

Project “The uses and the conservation of farm animal genetic resources under sustainable development” co-financed by the National Centre for Research and Development within the framework of the strategic R&D programme “Environment, agriculture and forestry” – BIOSTRATEG, contract number: BIOSTRATEG2/297267/14/NCBR/2016

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Received 5 May 2019; accepted for publication 20 November 2019