ACTA SCIENTIARUM POLONORUM

Acta Sci. Pol. Technol. Aliment. 22(3) 2023, 257–266

www.food.actapol.net pISSN 1644-0730 eISSN 1898-9594 http://dx.doi.org/10.17306/J.AFS.2023.1144

ORIGINAL PAPER

Received: 10.06.2023
Accepted: 11.09.2023

COMPARATIVE ANALYSIS OF THE CHEMICAL COMPOSITION, FUNCTIONAL-TECHNOLOGICAL, RHEOLOGICAL, AND ANTIOXIDANT PROPERTIES OF WILD BOAR MEAT (*SUS SCROFA*) WITH DFD PROPERTIES AND INDUSTRIAL PORK

Nataliia Volodymyrivna Bozhko[1]✉, Vasyl Ivanovich Tischenko[2], Vasyl Mykolayovich Pasichnyi[3], Andrii Ivanovich Marinin[4], Yuliia Anatoliivna Matsuk[5]

[1]Department of Biophysics, Biochemistry, Pharmacology and Biomolecular Engineering, Medical Institute, Sumy State University
Sanatornaya str., 31, Sumy, Ukraine, 40018
[2]Department of Technology and Food Safety, Sumy National Agricultural University
G. Kondratieva str., 160, Sumy, Ukraine, 40021
[3]Department of Technology of Meat and Meat Products, National University of Food Technologies
Volodumurska str., 68, Kyiv, Ukraine, 01601
[4]Problem Research Laboratory, National University of Food Technologies
Volodumurska str., 68, Kyiv, Ukraine, 01601
[5]Department of Food Technologies, Oles Honchar Dnipro National University
Gagarina Avenue, 72, Dnipro, Ukraine, 49000

ABSTRACT

Background. The aim of this work was to study the functional-technological, structural-mechanical, and antioxidant properties of wild boar meat as a perspective for meat processing and its comparative assessment with the meat of pigs grown in industrial conditions.

Materials and methods. The subject of the research was the longest back muscle (*Longissimus dorsi*) of a wild boar hunted in hunting grounds, as well as pork from industrial farms in the Sumy region, Ukraine.

Results and discussion. The work established that the meat of wild boars (*Sus scrofa*) has a high nutritional value, namely a higher protein content – 22.98 ±1.16%, a low fat content – 1.84 ±0.19% and, accordingly, a lower energy value – 115.49 kcal/100 g compared to the meat of domestic pigs. The conducted studies showed that the meat of wild pigs (*Sus scrofa*) has sufficiently high functional and technological indicators and is not inferior to the meat of industrial pigs. It was experimentally proven that the pH of the meat ranged from 6.7 in 1 hour after slaughter to 6.21 in 24 hours after slaughter. It was established that the water-binding capacity of wild boar meat is 51.8 ±0.11%, the water holding capacity is 68.2±0.20%, and the fat holding capacity is 40.2 ±0.13%. The meat of wild boars was characterized by a denser structure and consistency compared to the raw material of industrial pigs, regardless of the thermal condition. Minced meat from wild boar demonstrated the strongest properties: 2373.15 ±40.88 Pa×s in the cured state and 2504.31 ±61.09 Pa×s in the cooled state. The extent of technological losses during cooling, storage, and cooking for wild boar meat was less than for pork by 27.35, 25.93, and 11.57%, respectively. The dynamics of oxidation processes in wild boar meat was lower than in domestic pork. The concentration of free fatty acids in wild boar meat at the end of 16 days of chilled meat storage was lower by 26.67%, and peroxides were lower by 25.2%.

Conclusion. The meat of a wild boar is not inferior to the meat of domestic pork in terms of its functional, technological, and rheological properties, and according to certain indicators, it has a higher quality. Due to the low rate of oxidative deterioration, it can be stored longer than pork.

Keywords: wild boar meat, functional properties, antioxidant properties

✉natalybozhko@ukr.net, http://orcid.org/0000-0001-6440-0175

INTRODUCTION

The tendency to increase natural populations of wild boars, including in Ukraine, stimulated interest in game as a raw material for the food industry (Demartini et al., 2021; Czarniecka-Skubina et al., 2022). Wild boar (*Sus scrofa*) is a game animal (ungulate game) used for commercial and sport hunting worldwide.

Recently, meat products obtained from non-traditional slaughter animals such as deer, elk, wild boar, roe deer, etc., have received increasing attention on the consumer goods market. They are becoming attractive to the meat industry, restaurant business, and consumers as new, exclusive, ecological, and exotic types of meat and meat products. Wild boar meat (*Sus scrofa*) is a promising raw material in the production of meat products, especially for the restaurant and hotel industry.

Furthermore, unlike meat obtained in the modern system of farmed animals, which accounts for 18% of carbon dioxide, methane, and nitrous oxide in the total amount of pollution, wild boar meat is an organic food product of local origin (without breeding, heating, storage excrement, feeding, or feed production). The boar lives in the wild and is raised on a free range. Unlike the meat of animals from industrial farms, wild boars have not been selectively bred for centuries. Therefore, they do not suffer from many diseases that traditional farm animals suffer from (transmissible gastroenteritis, Aujeski's disease, swine fever), they are not given antibiotics or hormones (Tang et al., 2017). For these reasons, wild boar meat has a negligible carbon footprint compared to industrially produced meat, as it is a natural product.

Consumers also need food experience and information about whether the animal was free-range or farm-raised. Due to livestock diseases, data such as origin, traceability, and processing methods have become a major concern for consumers when purchasing meat products (Bureš et. al., 2018). According to the results of the survey, regarding the frequency and popularity of certain types of meat among consumers, it was established that 5% of respondents consider game meat to be the most popular type of meat, and 6% called it the most frequently consumed (Xazela et. al., 2017).

Wild boar meat is generally considered a delicacy and a special, often local, product valued by many consumers, leading to a steady increase in demand (Niewiadomska et al., 2020). Wennborg (2021) concluded that with a more efficient supply chain, meat from Swedish wild boar (*Sus scrofa*) could contribute to the long-term sustainability of the food chain.

The nutritional and biological value of wild boar meat has certain advantages, compared to domestic pork. Sampels et al. (2023) showed that the content of muscle fat in wild pigs was 4.5–5.2%, compared to 2.9% in domestic pigs. On the other hand, Żmijewski and Korzeniowski (2001) reported a lower mass fraction of fat and a high protein content in the meat of wild boars slaughtered in Poland.

The study of the fatty acid composition (Morán et al., 2019) showed a significantly higher amount of w-3 fatty acids in wild boar, especially 20:5 w-3 and 22:5 w-3. It was established that wild boar meat has a high content of fatty acid 18:3 n-3, which is abundant in grass and leaves (Pedrazzoli et al., 2017).

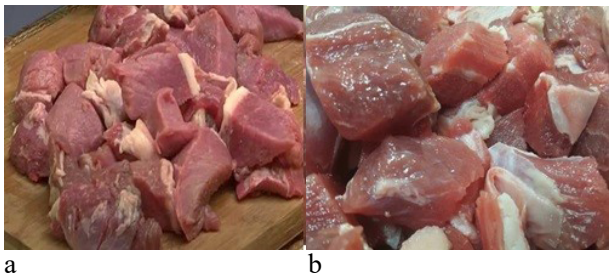
Long-chain PUFAs 20:5 w-3 and 22:5 w-3 can be partially synthesized by animals if they have sufficient 18:3 n-3 in their diet, or can be obtained naturally from the diet, for example, from lichens (Modzelewska-Kapituła and Żmijewski, 2021). However, the presence of long-chain unsaturated fatty acids in both adipose and muscle tissue creates a risk of oxidative spoilage of meat (Domínguez et al., 2019).

However, the issues of functional and technological properties of wild boar meat as a raw material for the production of meat products, as well as antioxidant processes occurring in post-mortem wild boar meat, are insufficiently studied. Therefore, the purpose of our work was to study the functional-technological, structural-mechanical, and antioxidant properties of wild boar meat, and its comparative assessment with the meat of pigs grown in industrial conditions.

MATERIALS AND METHODS

Sample Collection

The subject of research was the meat of a wild boar hunted in the hunting grounds of the Sumy region. The longest back muscle (*Longissimus dorsi*) from four male wild boars at the age of app. 12–14 months and with a body weight app. 60–65 kg was used to evaluate the nutritional value, functional-technological quality, and antioxidant properties of the meat. The meat was received at the end of November 2022 from



a b

Fig. 1. Meat of animals used in the experiment: a – wild boar meat; b – pork

a hunting enterprise in the Sumy region, Ukraine. The age of wild boars was estimated on the basis of tooth wear and replacement. Analogous muscles from four domestic pigs of the Ukrainian Large White breed (males aged 7 months with a body weight app. 100 kg) were obtained from the farm.

Chilled meat was stored in chambers with a relative humidity of 85...90%, a speed of air movement of 0.2...0.3 m/s, and a temperature of 0...-1°C. The study of indicators of oxidative deterioration was carried out in the original raw material in a cooled state and during 16 days of storage (12 standard days + 4 days of prolongation).

Cooking loss (%) was measured according to (Ludwiczak et al., 2019). The muscle slices (40–50 g) for the measurement of cooking loss were wrapped in thin plastic bags. The bags with meat were placed in a water bath set at 90°C until it reached the core temperature of 70°C (measured with thermocouples). Then, the samples were cooled to room temperature and reweighed (after removing excess moisture with a paper towel). Changes in the sample weight were calculated (%).

Determination of moisture content

Moisture content was measured using the method of drying (Bozhko et al., 2021). 5 g of the sample was placed in a container and dried to a constant mass at 103°C.

Determination of raw protein content

Protein was measured using the Kjeldahl method (Bozhko et al., 2021). 5 g of homogeneous fillet with 20 mL of concentrated sulfuric acid and 8 g of catalysts were placed in a special container and then heated at 350°C for 30 min. Then, the sample was quantitatively transferred to a solution of NaOH at a concentration of 33%, sealed, and distilled off with the steam. The resulting distillate was transferred to a flask with several drops of the Tashiro indicator. The titration was performed with a solution of 0.01 N sulfuric acid.

Determination of raw fat content

Total fat was measured by the Soxhlet method (Bozhko et al., 2021). 4 g of the dried meat in a paper cartridge was placed in an extraction flask of a Soxhlet apparatus. The extraction reagent was petroleum ether with a boiling point of 45°C. The constant weight of the test paper container was determined after multiple extractions. The difference between the initial and final weight shows the fat content.

Determination of ash content

Ash content was determined by heating the sample overnight at 520°C in a muffle furnace. The sample was weighed before and after heating to determine the content of ash. The ash content was calculated using the formula:

$$Ash = M_{ash}/M_{dry} \times 100 \quad (1)$$

where

M_{ash} is the mass of the ashed sample

M_{dry} is the initial mass of the dried sample.

Determination of the energy value

The energy value was calculated using the Atwater general factor system. The average values of energy are expressed as the number of calories per 1 gram of the macronutrients. There are energy values of 4 kcal per gram (kcal/g^{-1}) (17 kJ/g^{-1}) for protein, 4 kcal/g^{-1} for carbohydrates, and 9 kcal.g^{-1} (37 kJ.g^{-1}) for fat (FAO, 2003).

pH measurement

The pH of the mincemeat was measured using a Partabell digital pH meter pcd650. Samples were prepared to measure pH, based on the standard method (Bozhko et al., 2020), and 10 g of minced meat was mixed in 100 mL of water.

Methods of measuring functional indicators

The WBC (water binding capacity) of minced meat was determined using the pressing method (Bozhko et al., 2020). WBC_a is the water-binding capacity to the

moisture of the sample; WBC_m is the water-binding capacity to the mass of the sample. The WHC (water holding capacity) of minced meat was defined as the difference between the mass fraction of moisture in the minced meat and the amount of moisture released during the heat treatment.

Definition of rheological indicators

Rheological indices of minced systems were determined using a rotational viscometer. A RV-8m viscometer was used with a corrugated rotor (2 mm corrugation step) with an inner cylinder (Rc) of 0.605 cm, and an outer rotor radius of Rn – 1.9 cm; the length of the rotor was equal to 8 cm, it was on a scale, and a stopwatch was used. The processing of the obtained results was performed according to the method (Bozhko et al., 2020).

Lipid oxidation determined by acid value, peroxide value, and the content of thiobarbituric acid reactive substances

The acid value was measured using batch titration with sodium hydroxide in the concentration in the presence of phenolphthalein alcohol solution (Bozhko et al., 2019). 3-5 g of the sample was weighed in the conic flask. The batch was heated on the water bath and shaken after the addition of 50 cm^3 of neutralized ether-alcohol mixture. After adding3-5 drops of phenolphthalein alcohol solution, the received solution was shaken. Then the solution was titrated with 0.1 mol/dm^3 KOH until the distinct rose coloration appeared and remained for 1 min. The acid value was calculated by the formula:

$$X = (V \times K \times 5.61)/m \quad (2)$$

where:

V is volume of potassium hydroxide solution, with the molar concentration 0.1 mol/dm^3, used for titration

K is correction to alkali solution for recalculation on the distinct (0.1 mol/dm^3) one; 5.61 is number of milligrams of potassium hydroxide, contained in 1 cm^3 (0.1 mol/dm^3) of solution; m is forcemeat batch mass, g.

The method of peroxide value determination is based on batch extraction by the chloroform-icy acetic acid mix and further titration by the sodium hyposulfite solution with the presence of starch solution (Bozhko et al., 2019).

The peroxide value was calculated by the formula:

$$X = (V–V_1) \times K \times 0.00127 \times 100/m \quad (3)$$

where

V is a volume of sodium hyposulfite solution with the molar concentration 0.01 mol/dm^3, used for titration in the main experiment with the forcemeat batch, cm^3;

V_1 is a volume of sodium hyposulfite solution (0.01 mol/dm^3), used for titration in the control experiment without a forcemeat batch, cm^3;

K is the coefficient of correction to sodium hyposulfite for recalculation on the distinct (0.01 mol/dm^3) solution; 0.00127 is the number of grams of iodine, equivalent to 1 cm^3 (0.01 mol/dm^3) of sodium hyposulfite; and m is the mass of the studied forcemeat batch, g.

The thiobarbituric acid reactive substances were measured using the method (Bozhko et al., 2019). The content of thiobarbituric acid reactive substances, mg of MA (malonic aldehyde)/kg of the product, was calculated using the formula:

$$X = D \times 7.8 \quad (4)$$

where:

D is an optic density of the solution;

7.8 is a coefficient of proportional dependency of MA density on its concentration in the solution. This coefficient is a permanent value.

Statistical analysis

The absolute error of measurements was determined by Student criterion, the reliable interval P = 0.95. The number of repetitions in calculations was 3−4, and the number of parallel tests of studied samples was 3.

RESULTS AND DISCUSSION

Chemical composition of wild boar meat and industrially grown pork

The chemical composition of meat determines its technological properties, which form the basis for the development of technologies for the production of

Table 1. The chemical composition of wild boar meat and industrial pork

Meat	Moisture %	Protein, %	Fat, %	Ash, %	Energy value, kcal/100 g
Wild boar meat	73.59 ±2.93	22.98 ±1.16	1.84 ±0.19	0.87 ±0.065	108.48
Pork	73.52 ±.01	21.56 ±1.38	3.25 ±0.24	1.12 ±0.085	115.49

meat products. The results of the study of the chemical composition of wild boar meat and industrially grown pork are presented in Table 1.

The moisture content in the meat wild boar and industrial pork did not have a significant difference and ranged from 73.59 to 73.52%. However, the mass fraction of protein in wild boar meat was 6.59% higher and amounted to 22.98±1.16% ($p < 0.05$). Wild boar meat also had a lower fat content – 1.84 ±0.19%, which is 43.38% lower than industrial pork, which may indicate that the meat of wild pigs is of low quality. Nowadays, consumers prefer foods that are low in fat and cholesterol, so wild boar meat can be considered the best food for human consumption.

The studied types of meat also differed in energy value: commercial pork had a calorie content of 115.49 kcal per 100 g, while wild boar meat had 108.48 kcal, which is 6.07% lower. A lower concentration of the total content of minerals in the meat of wild pigs compared to reared pigs was noted. Thus, the ash content in wild boar meat was 0.87 ±0.065%, which is 22.32% lower than in pork.

Functional and technological properties of wild boar meat and industrially grown pork

The functional and technological properties of meat raw materials are determined by a set of indicators that characterize the ability to bind and hold moisture and fat (WBC – water-binding capacity, WHC – water-holding capacity, FHC – fat-holding capacity) and form stable emulsions (emulsifying capacity, stability of emulsion). The results of the study of functional and technological properties of wild boar meat and pork are presented in Table 2.

Signs of DFD (high WBC and pH values, dark red color, hard consistency, increased stickiness) were found in the first hour after slaughter when determining the pH of wild boar meat. These signs should not be considered as raw material defects, as they are characteristic of the meat of the vast majority of wild animals (Viganò et al., 2019).

The pH of the wild boar meat in the first hours after slaughter was close to neutral and was in the range of 6.7–7.1. This can be explained by the fact that the meat of wild pigs contains a significant amount of glycogen, creatine phosphate, and ATP, compared to the meat of domestic pigs, which indicates intensive processes of glycolysis in muscles.

It was found that in the process of maturation, the muscles lost their elasticity, thickened and hardened, and pH decreased to 6.2 as a result of phosphorolysis and amylolysis with the formation of lactic acid and glucose. The next period was characterized by the softening of the meat due to the breakdown of actomyosin in the presence of easily hydrolyzable phosphates. Changes in meat caused by autolytic processes were also observed during cold processing and storage.

The WBC of meat from wild animals was 51.8 ±0.11%, which is practically the same as domestic pork and indicates satisfactory technological properties that meet the requirements of meat processing production (not lower than 52.00%). It can be argued that the product

Table 2. Functional and technological properties of wild boar meat and industrial pork

Meat	pH_1	pH_2	WBC, %	WHC, %	FHC, %
Wild boar meat	6.7 ±0.08	6.21 ±0.17	51.81 ±0.11	68.23 ±0.20	40.24 ±0.13
Pork	5.58 ±0.53	6.06 ±0.30	49.32 ±0.20	62.71 ±0.17	32.62 ±0.03

pH_1 – hydrogen index of meat 1 hour after slaughter; pH_2 – hydrogen index of meat 24 hours after slaughter.

made using the meat of wild animals will be juicy enough due to less loss of juice during heat treatment.

The FHC of wild boar meat was 40.24 ±0.13%, which on average is 23.36% higher than domestic pork. Perhaps this is due to both the different morphology and the presence of rather powerful connective tissue and muscle layers, which form a special system of different densities.

Rheological properties of wild boar meat and pork

The next parameters analyzed were the rheological indicators presented in Table 3. These characteristics are especially important when evaluating meat intended for culinary purposes.

The meat of wild boars is characterized by a denser structure and consistency compared to raw materials from industrial pigs, regardless of the thermal state.

Determination of the value of the shear stress showed that minced meat from wild boar has the strongest properties (2373.15 ±40.88 та 2504.31 ±61.09 Pa×s).

This is due to the presence of a larger number of myofibrillar proteins, which in turn contributes to the strong binding of individual structural components of meat through water layers after grinding the raw materials and the formation of a strong protein matrix. Also, the increase in shear stress in wild boar meat can be explained by a higher content of collagen fibers and a decrease in muscle proteolysis (Hofbauer and Smulders, 2011). The amount and solubility of connective tissue present in different skeletal muscles or in different locations of the same muscle is a major factor in the development of toughness and/or tenderness of meat (Modzelewska-Kapituła et al., 2016).

Minced meat from wild boar also turned out to be more viscous than from pork, which indicates the presence of complete myofibrillar proteins (Florek et al., 2022), and a smaller proportion of fatty components in the minced meat, which increases the effective viscosity of the meat mass. Wild boar muscles contain relatively more type I and IIA fibers and less type IIB fibers compared to industrial pigs, which increases the viscosity of ground meat (Oshima et al., 2009). On the other hand, the reduction of the effective viscosity in pork indicates the possibility of obtaining a more tender and juicier product under the conditions of including this type of meat in the recipes of meat products. Therefore, when choosing directions of use and organization of the technological process of manufacturing food products involving the meat of wild pigs, not only its functional properties, but also rheological ones should be taken into account.

Technological losses of meat from wild boars (*Sus scrofa*) and domestic pigs during of processing

Losses of meat during refrigeration and heat treatment lead primarily to a decrease in moisture, which causes changes in the chemical composition of meat and changes its quality accordingly (Batorska et al., 2018). Table 4 presents the results of studies of technological losses in various methods of processing wild boar meat and pork.

Table 3. Rheological properties of wild boar meat and pork depending on the thermal state

Meat and thermal state	Wild boar		Pork	
	chilled	cooled	chilled	cooled
Shear stress, Pa	2 373.15 ±40.88	2 504.31 ±61.09	1 858.31 ±1,40	1 706.11 ±0.33
Effective viscosity Pa×s	557.30 ±6.21	543.10 ±11.70	509.70 ±5.31	508.20 ±11.30
Plasticity, sm^2/g	22.13 ±0.05	23.05 ±0.13	19.33 ±0.11	19.05 ±0.77

Table 4. Loss of meat mass during cold processing and during refrigerated storage, %

Meat	Loss of mass during cooling	Loss of meat during storage (3 days)	Loss after heat treatment (cooking)
Wild boar meat	1.62 ±0.31	0.27 ±0.87	35,63 ±0.57
Pork	2.23 ±0.17	0.34 ±0.51	40,29 ±0.86

The analysis of the table shows that with slow (one-stage) cooling, mass loss was higher in meat pork by 27.3% compared to meat from wild pigs. This is confirmed by (Batorska et al., 2018). Losses during heat treatment in wild boar meat amounted to 35.63 ±0.57%, which is 11.57% less than mass loss during heat treatment of commercial pork. Similar results were recorded by (Stanisz et al., 2019). The yield of cooking meat from wild boars was also 16.1% higher than meat from domestic animals. Obviously, these results are related to the technological features of growing, slaughtering, and obtaining the meat of industrial pigs and its morphological composition.

Lipid oxidative stability of the wild boar meat (*Sus scrofa*) and pork during the storage

Oxidation of lipids negatively affects not only sensory, but also functional characteristics of meat. A variety of primary and secondary by-products are formed during the process, depending on the types of fatty acids, the presence of oxygen, and the presence of pro- and antioxidants. Some of the products of lipid oxidation only affect meat quality, while others affect various diseases and human health (Huang and Ahn, 2019).

Table 5 presents the results of studies of hydrolytic degradation of lipids in wild boar meat and industrial pork.

Hydrolysis is an early step in the conversion of lipids to aromatic compounds by the formation of free fatty acids (FFA) from triacylglycerols and phospholipids (Wu et al., 2015). Acid value gradually increased during storage of both types of meat. However, the content of free fatty acids in pork increased more intensively compared to the meat of wild boars. At the end of the storage period, the AV of wild boar meat was 0.657 ±0.07 mg KOH, which is 26.67% less than in industrial pork. This is explained by the lower content of intramuscular fat in the meat of wild pigs, which is due to morphological differences caused by the lifestyle of wild animals (Razmaite et al., 2012).

Oxidation of free fatty acids is the second step in the transformation of lipids into aromatic compounds (Huang et al., 2014). Lipid oxidation, including autoxidation and enzyme-catalyzed fatty acid oxidation, causes the formation of hydroperoxides. Hydroperoxides decompose into secondary oxidation products such as aliphatic aldehydes, alcohols, ketones, and esters through a series of complex reactions. Lipoxygenases are key contributors to lipid oxidation in many different meat products (Wu et al., 2022).

The results of peroxide value determining are presented in Table 6.

The analysis of the table showed that the dynamics of oxidation at the second stage in industrial pork was faster. Thus, at the beginning, the concentration of peroxides in the meat of wild boar and pork was almost the same, but after 4 days it showed a significant difference. The PV of wild boar meat on the 4th day of storage was 0.0291 ±0.003 J_2%, which is 25.2% lower compared to the PV in pork.

The established trend was maintained until the end of the shelf life of cooled meat. On the 16th day of storage, the concentration of peroxides in industrial pork was 0.0716 ±0.001 J_2%, which is 35.06% higher

Table 5. Dynamics of the acid value of wild boar meat and pork during the storage, mg KOH

Meat	0 days	4 days	8 days	12 days	16 days
Wild boar meat	0.221 ±0.04	0.317 ±0.11	0.311 ±0.03	0.511 ±0.01	0.657 ±0.07
Pork	0.221 ±0.04	0.487 ±0.01	0.501 ±0.04	0.631 ±0.001	0.896 ±0.001

Table 6. Dynamics of the peroxide value of wild boar meat and pork during the storage, J_2%

Meat	0 days	4 days	8 days	12 days	16 days
Wild boar meat	0,0189 ±0,04	0,0291 ±0,003	0,0304 ±0,004	0,0527 ±0,005	0,0716 ±0,001
Pork	0,0191 ±0,04	0,0389 ±0,03	0,0511 ±0,01	0,0924 ±0,03	0,0967 ±0,001

compared to wild boar meat. Thus, the lower content of intramuscular fat in wild boar meat determines the resistance of fat to oxidation, compared to pork.

CONCLUSION

It was established that the meat of wild pigs (*Sus scrofa*) has a high nutritional value, namely, a higher protein content compared to the meat of industrial pigs – 22.98 ±1.16%, a low fat content – 1.84 ±0.19% and, accordingly, a lower energy value – 115.49 kcal/100 g.

The conducted studies showed that the meat of wild pigs (*Sus scrofa*) has sufficiently high functional and technological indicators and is not inferior to the meat of domestic pigs. It was experimentally proven that the pH of the meat ranged from 6.7 in 1 hour after slaughter to 6.21 in 24 hours after slaughter. It was established that the WBC of wild boar meat is 51.8 ±0.11%, WHC is 68.2 ±0.20%, and FHC is 40.2 ±0.13%.

It has been proven that the meat of wild boars has a denser structure and consistency compared to raw materials from industrial pigs, regardless of the thermal state. Minced meat from wild boar demonstrated the strongest rheological properties – 2373.15 ±40.88 Pa×s in the chilled state and 2504.31 ±61.09 Pa×s – in the cooled state. The effective viscosity and plasticity of wild boar meat were also higher compared to industrial pig meat, regardless of thermal condition.

The assessment of technological losses during meat processing showed that the extent of losses during cooling, storage, and cooking for wild boar meat was less than for pork by 27.35, 25.93, and 11.57%, respectively.

It was established that the dynamics of oxidation processes in wild boar meat were lower than in industrial pork. The concentration of free fatty acids in wild boar meat at the end of 16 days of cooled meat storage was lower by 26.67% and peroxides by 25.2%.

According to the obtained results, wild boar meat is a promising raw material for the food industry. In the further processing of such meat, it is possible to recommend the use of additional technological techniques (massaging or mechanical tenderisation, increasing the water content in emulsified meat products, additional fat, etc.) for effective processing of wild boar meat.

REFERENCES

Amaral, A. B., Silva, M. V. D., Lannes, S. C. D. S. (2018). Lipid oxidation in meat: mechanisms and protective factors – a review. Food Sci. Technol., 38, 1–15. https://doi.org/10.1590/fst.32518

Batorska M., Więcek J., Kunowska-Slósarz M., Puppel K., Slósarz J., …, Balcerak M. (2018). The effect of carcass weight on chemical characteristics and fatty acid composition of Longissimus dorsi and Semimembranosus muscles of European wild boar (*Sus scrofa scrofa*) meat. Can. J. Anim. Sci., 98(3), 557–564. https://doi.org/10.1139/cjas-2017-0090

Bozhko, N., Pasichnyi, V., Tischenko, V., Matsuk, Y. (2020). Analysis of the possibility of fish and meat raw materials combination in products. Potr. S. J. Food Sci., 14, 647-655. https://doi.org/10.5219/1372

Bozhko, N., Tischenko, V., Pasichnyi, V., Shubina, Y., Kyselov, O., Marynin, A., Strashynskyi, I. (2021). The quality characteristics of sausage prepared from different ratios of fish and duck meat. Potravinarstvo Slovak Journal of Food Sciences, 15, 26–32. https://doi.org/10.5219/1482

Bozhko, N., Tishchenko, V., Pasichnyi, V., Svyatnenko, R. (2019). Effectiveness of natural plant extracts in the technology of combined meat containing breads. Ukr. Food J., 8(3), 522–532. https://doi.org/10.24263/2304-974x-2019-8-3-9

Bureš, D., Bartoň, L.; Kudrnáčová, E., Panovská, Z., Kouřimská, L. (2018). Maso divokých zvířat a jeho role v lidské výživě [Meat of wild animals and its role in human nutrition]. Výživa Potraviny, 1, 9–13. [In Czech]. Available from: https://www.vyzivaspol.cz/wp-content/uploads/2018/02/maso1.pdf

Czarniecka-Skubina, E, Stasiak, D. M, Latoch, A, Owczarek, T, Hamulka, J. (2022). Consumers' perception and preference for the consumption of wild game meat among adults in Poland. Foods, 11(6), 830. https://doi.org/10.3390/foods11060830

Demartini, E., Vecchiato, D., Marescotti, M. E., Gibbert, M., Viganò, R., Giacomelli, S., Gaviglio, A. (2021). The more you know: The equivocal effects of prior knowledge on preferences for hunted vs. farmed wild boar meat. Int. J. Gastron. Food Sci., 24, 100325. https://doi.org/10.1016/j.ijgfs.2021.100325

Domínguez, R., Pateiro, M., Gagaoua, M., Barba, F. J., Zhang, W., Lorenzo, J. M. (2019). A comprehensive review on lipid oxidation in meat and meat products. Antioxidants, 8(10), 429. https://doi.org/10.3390/antiox8100429

Florek, M., Domaradzki, P., Skałecki, P., Ryszkowska-Siwko, M., Ziomek, M. …, Pyz-Łukasik, R. (2022). Content and solubility of collagen and their relation to proximate composition and shear force of meat from different anatomical location in carcass of European beaver (*Castor fiber*). Foods, 11(9), 1288. https://doi.org/10.3390/foods11091288

Hofbauer, P., Smulders, F. J. M. (2011). The muscle biological background of meat quality including that of game species. In: P. Paulsen, A. Bauer, M. Vodnansky, R. Winkelmayer, F. J. M. Smulders (eds), Game meat hygiene in focus (p. 273–295). Wageningen, the Netherlands: Wageningen Academic Publishers. https://doi.org/10.3920/978-90-8686-723-3_21

Huang, X., Ahn, D. U. (2019). Lipid oxidation and its implications to meat quality and human health. Food Sci. Biotech., 28, 1275–1285. https://doi.org/10.1007/s10068-019-00631-7

Huang, Y., Li, H., Huang, T., Li, F., Sun, J. (2014). Lipolysis and lipid oxidation during processing of Chinese traditional smoke-cured bacon. Food Chem., 149, 31–39. https://doi.org/10.1016/j.foodchem.2013.10.081

Ludwiczak, A., Składanowska-Baryza, J., Stanisz, M. (2020). Effect of age and sex on the quality of offal and meat of the wild boar (*Sus scrofa*). Animals, 10(4), 660. https://doi.org/10.3390/ani10040660

Modzelewska-Kapituła, M., Nogalski, Z., Kwiatkowska, A. (2016). The influence of crossbreeding on collagen solubility and tenderness of *Infraspinatus* and *Semimembranosus* muscles of semi-intensively reared young bulls. Anim. Sci. J., 87, 1312–1321. https://doi.org/10.1111/asj.12581

Modzelewska-Kapituła, M., Żmijewski, T. (2021). The influence of age and gender on the quality of raw and roasted wild boars (*Sus scrofa*) meat. Meat Sci., 181, 108600. https://doi.org/10.1016/j.meatsci.2021.108600

Morán, L., Insausti, K., Barron, L. J. R., Aldai, N. (2019). Wild boar – production, meat quality traits and derived products. In: J. Lorenzo, P. Munekata, F. Barba, F. Toldrá, (eds), More than beef, pork and chicken – the production, processing, and quality traits of other sources of meat for human diet (p. 211–226). Cham, Switzerland: Springer. https://doi.org/10.1007/978-3-030-05484-7_8

Niewiadomska, K., Kosicka-Gębska, M., Gębski, J., Gutkowska, K., Jeżewska-Zychowicz, M., Sułek, M. (2020). Game meat consumption – conscious choice or just a game? Foods 9, 1357. https://doi.org/10.3390/foods9101357

Oshima, I., Iwamoto, H., Nakamura, Y.-N., Takayama, K., …, Nishimura, S. (2009). Comparative study of the histochemical properties, collagen content and architecture of the skeletal muscles of wild boar crossbred pigs and commercial hybrid pigs. Meat Sci., 81, 382–390. https://doi.org/10.1016/j.meatsci.2008.08.014

Pedrazzoli, M., Bosco, A. D., Castellini, C., Ranucci, D., Mattioli, S., Pauselli, M., Roscini, V. (2017). Effect of age and feeding area on meat quality of wild boars. Ital. J. Anim. Sci., 16, 353–362. https://doi.org/10.1080/1828051X.2017.1292114

Razmaite, V., J. Švirmickas, G., Šiukščius, A. (2012). Effect of weight, sex and hunting period on fatty acid composition of intramuscular and subcutaneous fat from wild boar. Ital. J. Anim. Sci., 11(2), e32. https://doi.org/10.4081/ijas.2012.e32

Sampels S, Jonsson, M, Sandgren, M, Karlsson, A, Segerkvist, K. A. (2023). Sustainable delicacy: variation in quality and sensory aspects in wild boar (*Sus scrofa*). Meat and comparison to pork meat-a case study. Foods. 12(8), 1644. https://doi.org/10.3390/foods12081644

Stanisz, M., Ludwiczak, A., Składanowska-Baryza, J., Bykowska-Maciejewska, M. (2018). The effect of age and ultimate pH value on selected quality traits of meat from wild boar. Can. J. Anim. Sci., 99, 336–342. https://doi.org/10.1139/cjas-2018- 0090,2019

Tang, K. L., Caffrey, N. P., Nóbrega, D. B., Cork, S. C., Ronksley, P. E., Barkema, H. W., Ghali, W. A. (2017). Restricting the use of antibiotics in food-producing animals and its associations with antibiotic resistance in food-producing animals and human beings: a systematic review and meta-analysis. Lancet Planet. Health, 1, e316-e327. https://doi.org/10.1016/S2542-5196(17)30141-9

Viganò, R, Demartini, E, Riccardi, F, Corradini, A, Besozzi, …, Gaviglio A. (2019). Quality parameters of hunted game meat: Sensory analysis and pH monitoring. Ital. J. Food Saf., 8(1). https://doi.org/10.4081/ijfs.2019.7724

Wennborg, O. (2021). The development of an efficient wild boar meat supply chain. Opportunities, challenges, and limitations from a case study of Swedish game suppliers and hunters. Master thesis in Food science. Sveriges Lantbruksuniversitet: Uppsala, Sweden. https://stud.epsilon.slu.se/16479/3/wennborg_o_210226.pdf

Wu, H., Forghani, B., Abdollahi, M., Undeland, I. (2022). Lipid oxidation in sorted herring (*Clupea harengus*) filleting co-products from two seasons and its relationship to composition. Food Chem., 373, 131523. https://doi.org/10.1016/j.foodchem.2021.131523

Wu, H., Zhuang, H., Zhang, Y., Tang J., Yu, X., Long, M., Zhang, J. (2015). Influence of partial replacement of NaCl with KCl on profiles of volatile compounds in

dry-cured bacon during processing. Food Chem., 172, 391–399, 10.1016/j.foodchem.2014.09.088

Xazela, N., Hugo, A., Marume, U., Muchenje, V. (2017). Perceptions of rural consumers on the aspects of meat quality and health implications associated with meat consumption. Sustainability, 9, 830. https://doi.org/10.3390/su9050830

Żmijewski, T., Korzeniowski, W. (2001). Technological properties of wild boars meat. Electron. J. Pol. Agric. Univ., 4 (2). Available online: http://www.ejpau.media.pl/volume4/issue2/food/art-02.html.