POLISH JOURNAL OF FOOD AND NUTRITION SCIENCES

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Pol. J. Food Nutr. Sci.
2007, Vol. 57, No. 4(C), pp. 523-528

# COMPARISON OF CHOSEN QUALITY PARAMETERS OF MEAT FROM WILD BOAR AND DOMESTIC PIGS

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Key words: wild boar, Polish Large White pig, pork, meat quality

The study was conducted on m. *longissimus lumborum* (LL) muscle excised from 6 carcasses of wild boars (WB) at the age of living app. 9 months and with the body weight app. 32 kg. Boars were shut on the hunting area of Lubuskie province. As a control group LL muscle (6 pieces) obtained from domestic pigs Polish Large White (PLW) race of the age app. 6 months and body mass app. 120 kg was used. Pigs were slaughtered in commercial abattoir. Analyses were performed on fresh meat (NS) and on meat which was stored at the temperature close to cryoscopic point, *i.e.* -1°C±0.2°C for 14 (S14) and 28 days (S28) as well as on meat kept in freezer at a temp. -18°C±1°C for 28 days (SF). The part of this experiment was carried out on fresh and stored meat which was thermally processed at temperature 90°C until 72°C in geometrical centre of the product was reached. The aim of the study was to evaluate the physicochemical parameters and microbiological quality of meat from wild board in comparison to domestic pigs meat. Material obtained from wild boars and PLW pigs did not show any significant differences when $pH_{24}$ and total collagen content were measured. However, wild boar's meat had higher content of soluble collagen. LL muscles excised from wild boar carcasses were characterised by almost three-times smaller loin eye area than meat collected from domestic pigs. Moreover, meat from wild animals had significantly darker colour, which was represented by higher values of $a^*$ and $b^*$ colour parameters in reflectance spectrum. Higher amount of lipids and lower water content were analysed in boar's loins. However, this meat showed significantly better ability to bind and keep water in its structure, WHC as well as cutting force value was lower for this material. Stored meat from wild boars was characterized by few times smaller weight loss in comparison to domestic pigs muscles. Free amine group content measured either in fresh or stored for 14 days meat was higher for muscles collected from wild animals. However, in meat stored at a temp. -1°C and -18°C for 28 days higher dynamic of free amine group formation was observed for meat from pigs kept on the farm. Reduction in microbiological infection was observed in wild boar loins during storage of meat at the temperature close to cryoscopic point. After 28 days of storage in these conditions the rate of microbiological contamination was similar for both analysed type of meat. It can be concluded that in some aspects meat collected from wild boars is characterized by higher quality than meat obtained from domestic pigs. Especially high suitability of wild boar's loins to long storage at the temperature close to cryoscopic point is worth to underline.

## INTRODUCTION

Nowadays, consumers are eager to consume meat from other than traditionally housed animal species. Some of the reasons for consuming game meat are that consumers want to change daily menu and look for something special, they are also convinced that venison meat is characterised by high sensory, nutritive and health-promoting values [Rywotycki, 2003; Soriano *et al*., 2006; Vergara *et al*., 2003]. There are many circumstances, which proof that meat from wild animals can be eagerly consumed. Those animals live in welfare, have unlimited access to natural pastures and they are naturally selected. Living conditions of wild animals are correlated with the chemical composition of meat, which is characterised by very high content of macro- and microelements, beneficial ratio between polyunsaturated and saturated fatty acids, generally lower caloric value, as well as specific desired smell and taste [Petkov, 1985; Petkov & Monov, 1985; Petkov, 1988, Smolińska, 1976; Szczepański *et al*., 2007a,b; Korzeniowski & Żmijewski, 2001; Aidoo & Haworth, 1995; Drew, 1992; Drozd, 1997; Forss & Manley, 1977; Herzog, 1994a,b; Korzeniowski *et al*., 1975; Łabecka & Gardzielewska.1975; Mojto *et al*., 1993; Uherova *et al*., 1992]. Additional advantage of venison meat is its optimal aminoacids composition [Smolińska, 1976; Korzeniowski *et al*., 1991; Korzeniowski & Żmijewski, 2001]. Apart from many attractive consumer traits, game meat possesses a high technological value [Gronek *et al*., 1994; Gronek & Buczyński, 1996; Szmańko *et al*., 2007]. Lachowicz & Żachowska [2002] reported that products made from venison meat have highly desired texture. However, meat obtained from wild animals can express some disadvantages, too. Due to freedom of movement and unlimited access to agriculture and forestry cultivations animals can be exposed to *i.e.* pesticides and other plant protection substances, contaminated plants, nearness of different factories, as well as roads and motorways [Zasadowski *et al*., 1988; Petkov, 1988]. Venison meat sanitary conditions can be undisputable problem, especially with meat which is obtained at unfavourable weather conditions, *i.e.* high temperature or presence of mature male within killed animals [Gill, 2007; Paulsen *et al*., 2003].

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Taking all those different conditions under consideration the aim of the study was to compare the quality of wild boar meat obtained from traditionally hunted animals and boars kept on a industrial farm and killed at a very high sanitary conditions.

## MATERIALS AND METHODS

Material used in the experiment was *musculus longissimus lumborum* (LL) excised from the carcasses of 9 month wild boars (WB) (*Sus scrofa ferus*) hunted traditionally, with living weight approximately 32 kg. As a control group pork loin (LL) cut from Polish Large White pigs (PLW) with living weight app. 120 kg, which were housed at a industrial conditions, slaughter at meat factory with HACCP system. Muscles were excised from the wild boar's and fattener's carcasses 24 h *post mortem* at the temperature 4°C and then analysed. pH value of meat was measured with MICROCOMPUTER CP-551 pH-meter. Following analyses were done: dry matter content according to PN-ISO 1442:2000, protein content according to Kjeldahl method [PN-75/A-04018], fat content with Soxhlet method [PN ISO 1444:2000]. Apart from that colour was measured colorimetrically with $L^*$, $a^*$, $b^*$ scale. Water holding capacity (WHC) of meat was analysed according to Grau-Hamm method with the modification of Szmańko, [Szmańko, 1986]. Shear force was measured on Stevens equipment on the samples which were cut parallel to muscle fibers, then, during analysis, perpendicularly to the fibers. Collected results were statistically analysed with STATISTICA ver 5.0. Multidimensional analysis of variance with probability level of $p \leq 0.05$ was performed.

## RESULTS AND DISCUSSION

Experimental conditions did not effect pH value of meat (Table 1). Meat excised from WB carcasses stored for 14 days at the temperature close to cryoscopic point (tcc) had lower pH. Tendency to higher pH was observed for wild boar's meat. Proper reaction of meat from experimental pigs proved a good quality of this raw material. According to previously carried out study the reaction of fresh meat from wild boar was 5.69, then after partially defrosting and repeated storage pH of meat was 5.8 [Szmańko, 1979a,b]. Marchiori & Felicjo [2003] when compared the quality of meat from Brazilian wild boars with pork obtained lower $pH_{24}$ than in presented study. However, comparable to our results meat excised from wild boars was characterized by higher pH value.

The most evident morphological difference between PLW and WB was the structure of LL muscle. Loin eye area of WB (25.55 $cm^2$) was almost three times lower than for muscles cut from PLW (73.05 $cm^2$). Such a difference was predictable and it was the consequence of breeding conditions, which was carried out for many years, and breeding development. The influence of genotype on loin eye area was also analysed in previous research, in with the value of described parameter for meat from PLW equalled 96 $cm^2$, whereas for crossbred animals (25% WB genes and 75% PLW genes) was on the level of 80 $cm^2$ [Szczepański *et al*., 2007].

Weight loss during storage of the chunks excised from WB and PLW carcasses increased along to storage time at the temperature close to cryoscopic point (Table 1). Meat obtained from wild boar was characterised by almost three times lower weight loss during storage at mentioned conditions, either for 14 or 28 days. The results collected in this study for analysed parameter was also lower than those reported by Daszkiewicz [2007] for vacuum packed deer saddle stored at 2°C for 21 days. Frozen storage of PLW elements resulted in lower weight losses in comparison to storage at cryoscopic point. However, meat from WB was characterised by higher weight losses after 28 days of storage than meat from domestic pigs. Leakage of meat juice, especially of stored culinary meat, is not desired due to esthetic and hygienic points of view. Thus, venison meat is more suitable for storage in comparison to pork. According to other research, weight losses after frozen storage of wild boar's hams were significantly lower *i.e.* on the range from 1.6 to 2%, however, analysed elements were much bigger (approx. 7 kg) than evaluated in this study [Szmańko, 1979].

Meat excised from wild boar was characterized by similar or slightly higher dry matter content in comparison to PLW meat (Table 2). The results collected in this study confirmed previously obtained data for dry matter content in PLW meat

TABLE 1. pH value, weight loss and water holding capacity (WHC) of meat during storage, n = 12.

| parameters | | Experimental groups | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | PLW | | | | WB | | | |
| | | Fresh meat | Stored at -1°C 14 days | Stored at -1°C 28 days | Stored at -18°C 28 days | Fresh meat | Stored at -1°C 14 days | Stored at -1°C 28 days | Stored at -18°C 28 days |
| pH | $\bar{x}$ | 5.68 | 5.67 | 5.67 | 5.62 | 5.71 | 5.63 | 5.69 | 5.70 |
| | SD | 0.12 | 0.08 | 0.08 | 0.08 | 0.03 | 0.05 | 0.03 | 0.00 |
| Weight loss during storage (%) | $\bar{x}$ | - | 7.83bB | 14.30cB | 6.34aB | - | 2.46aA | 3.24bA | 4.76cA |
| | SD | - | 0.46 | 0.28 | 0.47 | - | 0.35 | 0.36 | 0.32 |
| WHC (%) | $\bar{x}$ | 52.98aA | 55.74bA | 60.07cB | 56.32bA | 56.63aB | 56.53aB | 58.21bA | 56.93cB |
| | SD | 1.80 | 1.32 | 2.08 | 1.43 | 2.47 | 1.73 | 1.71 | 1.31 |

a,b,c… – means in the same row followed by differentiated small letters are significantly differ at $p \leq 0.05$ within experimental groups (PLW, WB); A,B,C… – means in the same row followed by differentiated capital letters are significantly differ at $p \leq 0.05$ between experimental groups (PLW, WB) at the same storage conditions

TABLE 2. Chemical composition of meat, n = 18.

| Parameters | | Experimental groups | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | PLW | | | | WB | | | |
| | | Fresh meat | Stored at -1°C 14 days | Stored at -1°C 28 days | Stored at -18°C 28 days | Fresh meat | Stored at -1°C 14 days | Stored at -1°C 28 days | Stored at -18°C 28 days |
| Dry matter content (%) | $\bar{x}$ | 24.55aA | 25.75b | 26.10b | 25.99bA | 27.41bB | 25.64a | 26.08a | 27.13bB |
| | SD | 0.59 | 0.75 | 0.50 | 0.65 | 0.95 | 0.72 | 0.84 | 0.88 |
| Fat content (%) | $\bar{x}$ | 1.60aA | 2.29c | 1.82ab | 2.16bc | 2.62bB | 2.56ab | 2.06a | 2.33ab |
| | SD | 0.40 | 0.55 | 0.64 | 0.65 | 0.93 | 0.61 | 0.47 | 0.81 |
| Crude protein content (%) | $\bar{x}$ | 22.63aB | 23.41bcB | 23.79cB | 23.07ab | 21.66aA | 22.00abA | 22.55bA | 23.36c |
| | SD | 0.29 | 0.69 | 0.30 | 0.51 | 0.56 | 0.78 | 0.36 | 0.37 |
| Soluble protein content (%) | $\bar{x}$ | 8.34bB | 7.47aB | 7.41aB | 7.50aB | 6.41bA | 6.18abA | 6.17abA | 5.93aA |
| | SD | 0.24 | 0.47 | 0.60 | 0.43 | 0.57 | 0.55 | 0.19 | 0.49 |
| Collagen content (%) | $\bar{x}$ | 0.70B | - | - | - | 0.55A | - | - | - |
| | SD | 0.22 | - | - | - | 0.20 | - | - | - |
| Soluble collagen content (%) | $\bar{x}$ | 0.056 | 0.061A | 0.052A | 0.060 | 0.063 | 0.074B | 0.073B | 0.072 |
| | SD | 0.02 | 0.02 | 0.02 | 0.03 | 0.02 | 0.02 | 0.02 | 0.01 |
| Free amine group content (μgGly/g protein) | $\bar{x}$ | 5408aA | 6383bA | 7677c | 8753dB | 6902aB | 7192bB | 7558c | 7668cA |
| | SD | 265 | 359 | 294 | 341 | 262 | 308 | 303 | 426 |

a,b,c… – means in the same row followed by differentiated small letters are significantly differ at p≤0.05 within experimental groups (PLW, WB); A,B,C… – means in the same row followed by differentiated capital letters are significantly differ at p≤0.05 between experimental groups (PLW, WB) at the same storage conditions

and meat from crossbred of PLW with WB, which had almost 3% higher content of dry matter [Szczepański *et al*., 2007].

Within all experimental groups of wild boars the tendency to have a higher fat level in meat was observed. However, significant differences were noticed only for non-stored meat. Generally, venison meat is considered as more dietetic, especially due to having fewer amounts of lipids than domestic animals. Such a tendency is not observed during autumn-winter season, when meat is fattier, because of the fact that animals consume more fodder in order to gain weight for winter. Comparable fat content in meat from PLW was reported by Szczepański *et al*. [2007]. Moreover, they found that meat from crossbred pigs with wild boar (PLW x WB) is characterised by lower intramuscular fat than pure bred animals, what confirmed the hypothesis that wild boars meat consists of lower fat amount.

Exceptional sensory value of wild boar meat is based on the total lack of marbling. Despite the fact, that meat from WB had higher amount of total lipids, in comparison to PLW, fat was not visible in the microstructure of muscle tissue. It can be explained by the fact that fat was restricted in a very fine clusters or a very small cells. This can tend to the higher acceptability of meat due to the estimation of higher tenderness and juiciness. In case of domestic pigs, lack of marbling was observed in LL muscle at approx. 16.67% of cases, however about 1/3 of the population was characterised by small and half of them with limited marbling. Previously carried out investigation [Szczepański *et al*., 2007a] proved that meat from pure PLW pigs expressed small marbling, in comparison to crossbred animals. Sensory evaluation of meat from crossbred animals (PLW x WB) showed that marbling was limited or not present (1.4 point).

Higher amount of fat in wild boar meat compare to PLW resulted in lower protein content. For meat obtained from pure PLW pigs, in SF experimental group, adverse tendency was noticed. Results of the study confirmed data published by Szczepański *et al*. [2007] for protein content in PLW loins (app. 23.14%). Moreover, cited authors stated that crossbred animals (PLW x WB) were able to produce meat with higher protein content (23.91%), which confirmed that meat from wild animals contains more protein.

During the whole experiment, meat from WB was characterised by lower content of soluble protein in relation to the overall protein quantity, what could be explained by higher intensity of post mortem changes in venison meat. Higher content of free amine group analysed in wild boar meat from NS and S14 groups confirmed more advanced changes in this type of meat. Along to storage time this tendency was changed. After 28 days of storage of meat at the temperature close to cryoscopic point meat was characterised by the tendency to higher content (Table 2) of free amine group, however, WB meat kept in frozen state had significantly lower content of free amine group.

Wild boar meat was characterised by significantly lower collagen content in comparison to PLW pigs. Collagen found in WB meat was more soluble. This, additionally, improves the culinary quality of wild boars meat. Similar results were reported by Szczepański *et al*. [2007], who observed 1.1% of collagen in loins obtained from PLW pigs compare to 1.5% found in crossbred pigs with wild boar (when 25% of wild boar genes was used).

Meat possessed from wild boars was generally characterised by higher water holding capacity (WHC) than PLW

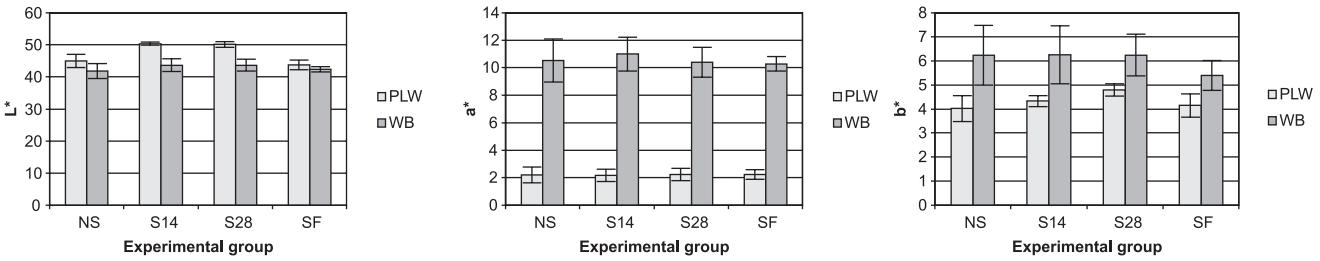


FIGURE 1. Colour parameters (L*, a*, b*) of meat, n=12.

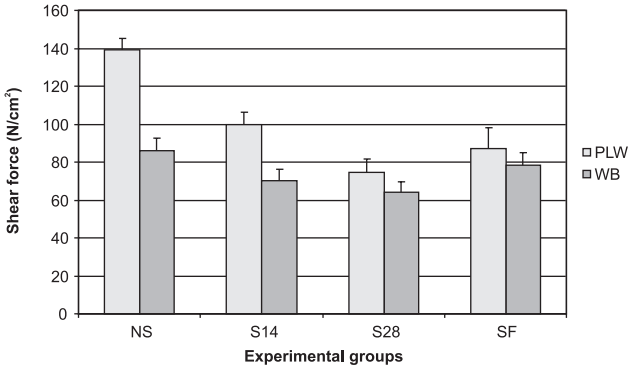


FIGURE 2. Shear force of meat, n=12.

meat (Table 1). However, one exception was found for meat stored for 28 days (S28). WHC, analysed in parallel research, for PLW meat was on the level of 59.30%, whereas for crossbred animals (PLW x WB) 65.37%. The results collected in presented study confirmed those published by Marchiori & Felicio [2003], that meat from wild boars had higher WHC, than domestic pigs.

Colour is the most differentiated parameter for meat obtained from pigs and wild boars (Figure 1). WB meat was characterised by lower lightness (L*), as well as higher values of red (a*) and yellow (b*) colour parameters when compare with PLW meat. Darker colour of venison meat is connected with higher myoglobin content, and at the same time higher quantity of biologically available iron, which is an additional nutritional advantage of this raw material. Szczepański *et al*. [2007] reported that meat from PLW pigs was characterised by higher lightness, redness and yellowness in comparison to crossbred animals (PLW x WB) (lower L* and higher a* and b*). Results collected in this study confirmed those reported by Marchiori & Felicio [2003], that wild boar meat expressed lower lightness and higher redness. Moreover, Daszkiewicz [2007] found that meat excised from hind had at least twice higher a* value than meat from wild boars carcasses.

Quality of culinary meat is also expressed by the value of shear force, which is connected with the sensory evaluated meat tenderness. Meat from wild boars was characterised by significantly lower shear force values when compare with PLW pigs, even though meat was obtained from approx. 3 months older animals (Figure 2). The results confirmed data published by Szczepański *et al*. [2007], which measured lower shear force value for meat from crossbred pigs (PLW) with wild boar (WB) (only 25% of WB genes).

Microbiological contamination of meat is one of the most important quality parameters of food, including culinary meat. The aim of this study was to compare the quality of meat obtained during traditional hunting, *i.e.* without assurance of high sanitary conditions, and the industry slaughter procedure, which obey the rules of very high hygienic standards, including HACCP system. Such a different slaughter conditions effected the microbiological standards of meat, especially during the first steps of the experiment, where meat was analysed as fresh. Venison meat was characterised by almost two times higher microbiological contamination than PLW meat. However, the level of contamination was not danger and equaled 3.7x $10^3$ cfu/g (Figure 3). According to Decastelli *et al.* [1995] microbiological contamination of wild boar carcasses is dependent on slaughter conditions, and it ranges from $10^5$ to $10^8$ cfu/g or from $10^3$ to $10^6$ cfu/g. Storage of meat at the temperature close to cryoscopic point did not influence the microbiological state of PLW meat, whereas general number of bacteria in meat possessed from WB decreased of about one logarithmic cycle. There was also observed an interesting fact, that frozen WB meat was characterised by few times lower microbiological contamination than PLW meat. Daszkiewicz [2007] reported that microbiological contamination of vacuum packed fillet of venison stored at 2°C for 21 days increased to the level of 6.11 log cfu/g and it was much higher than results collected in presented study.

When analysed the effect of twofold defrosting on microbiological quality of wild boars meat Szmańko [1979], stated that the general number of bacteria counted in hams was of about one cycle higher than in present study. However, ham in contrary to loin when excised from wild boars carcass, is only partially covered with skin and it can be more prone to microbiological contamination.

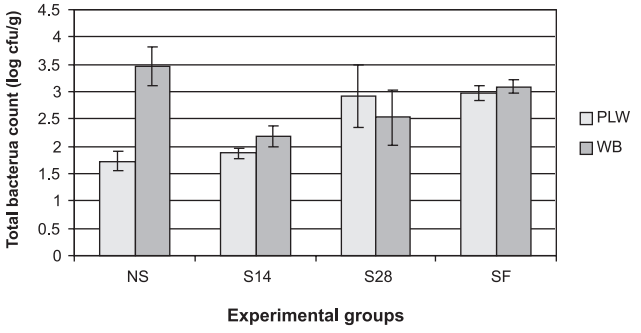


FIGURE 3. Total number of bacteria analysed in meat (log cfu/g), n=6.

## CONCLUSIONS

Result collected in the study revealed, that meat from wild boars, in many aspects, was characterised by higher quality in comparison to meat from domestic pigs. The most valuable quality traits of wild boar meat were high tenderness, high water holding capacity, low quantity of weight loss during storage, resistance to microbiological contaminations and longer durability of the final products, especially at the temperature close to cryoscopic point.

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# PORÓWNANIE WYBRANYCH PARAMETRÓW JAKOŚCIOWYCH MIĘSA DZIKÓW ORAZ ŚWINI DOMOWEJ

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Materiałem doświadczalnym był mięsień najdłuższy lędźwi *musculus longissimus lumborum* (LL) pobrany z 6 tusz dzików (WB) (*Sus scrofa ferus*), w wieku około 8-9 miesięcy i masie około 32 kg, ustrzelonych na łowiskach Ziemi Lubuskiej. Grupą odniesienia był mięsień LL (6 sztuk), pozyskany z tusz świń rasy wielkiej białej poskiej (PLW), w wieku 6 miesięcy, o masie przedubojowej 120 kg, ubitych w zakładzie mięsnym na terenie Wielkopolski. Badano jakość mięsa surowego nieprzechowywanego (NS) oraz przechowywanego w temperaturze bliskiej krioskopowej (-1°C±0,2) przez 14 dób (S14) i 28 dób (S28) oraz w temp. -18°C±1 przez 28 dób (SF) a także mięsa nieprzechowywanego i przechowywanego poddanego obróbce cieplnej w temp. 90°C do temp. 72°C w centrum geometrycznym. Przedmiotem badań były parametry fizykochemiczne oraz mikrobiologiczne mięsa. Mięso dzików i świń rasy PLW nie różniło się pod względem $pH_{24}$ oraz zawartości kolagenu ogólnego. Jednak więcej kolagenu rozpuszczalnego oznaczono w mięsie dzików. Mięśnie LL dzików charakteryzowały się niemal trzykrotnie mniejszą powierzchnią „oka polędwicy", ciemniejszą barwą, odznaczającą się większym udziałem składowej $a^*$ i $b^*$ w widmie odbiciowym, większą zawartością tłuszczu a mniejszą wody przy równocześnie większej WHC i mniejszej sile cięcia. Po przechowywaniu mięso dzików charakteryzowały kilkakrotnie mniejsze ubytki masy. Mięso dzików nieprzechowywane oraz przechowywane przez 14 dób odznaczało się większą zawartością wolnych grup aminowych. Podczas dalszego przechowywania przez 28 dób w temp. -1°C i -18°C obserwowano większą dynamikę tworzenia się wolnych grup aminowych w mięsie świń rasy PLW. W trakcie przechowywania krioskopowego obserwowano redukcję zakażenia mięsa dzików, po 28 dobach było ono podobne jak w mięsie PLW. Przeprowadzone badania wykazały, że mięso dzików pod wieloma względami charakteryzuje wyższa jakość aniżeli mięso świni domowej, szczególnie cenną właściwością jest niższa siła cięcia, dobre właściwości funkcjonalne, niskie ubytki przechowalnicze, oporność na zanieczyszczenie mikrobiologiczne a w rezultacie przydatność do długiego przechowywania, zwłaszcza w warunkach temperatury bliskiej krioskopowej.