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THE INFLUENCE OF THE CASTRATION METHOD AND THE WEIGHT BEFORE SLAUGHTER ON THE INDICATORS OF THE MEAT CUTS OF PIG CARCASSES

Oleksandr MYKHALKO[1*], Mykola POVOD[1*], Bogdan GUTYJ[2], Michael HYLL[3], Tetyana VERBELCHUK[4*], Serhii VERBELCHUK[4], Serhii LUHOVYI[3], Victor SHUPLYK[5], Yurii KOVALCHUK[6], Vira KOBERNIUK[4***]**

[1]Sumy National Agrarian University, Department of Feed Technology and Animal Feeding, 160, H. Kondratiiev Street, Sumy, Ukraine, Phones: +38(066)2871386, +38(095)5488087, E-mails: snau.cz@ukr.net, nic.pov@ukr.net
[2]Stepan Gzhytskyi National University of Veterinary Medicine and Biotechnologies, Department of Pharmacology and Toxicology Employment, 50, Pekarska Street, Lviv, Ukraine, Phone: +38(068)1362054, E-mail: bvh@ukr.net
[3]Mykolaiv National Agrarian University, [*]Department of genetics, animal feeding and biotechnology, [**]Department of livestock production technology, 9, Georgy Gongadze Street, Mykolaiv, 54000, Ukraine, Phone: +38(095)5488087, E-mail: gill@mnau.edu.ua, lugsergey23@gmail.com
[4]Polissia National University, [*]Department of Animal Breeding and Selection, [**]Department of animal feeding and feed technology, [***]Department of feeding, breeding of animals and preservation of biodiversity, 7, Staryi Boulevard, Zhytomyr, Ukraine, Phone: +38(098)2482590, +380(+38(067)1697709, +380671697709, E-mails: ver-ba555@ukr.net, verba5551@ukr.net, kobernukvera@gmail.com
[5]Podillia State University, Department of Technologies of Livestock Production and Cynology,12, Shevchenko Street, Kamianets-Podilskyi, Khmelnytskyi region, 32300, Ukraine, E-mail: shuplyk1@gmail.com
[6]Uman National University of Horticulture, Department of processes, machines and equipment of agro-industrial production, 1, Instytutska Street, Cherkasy region, Ukraine, Phone: +38(096)8658470, E-mail: temp14053@gmail.com

Corresponding author: snau.cz@ukr.net

Abstract

The aim of the article was to investigate the dependence of the slaughter characteristics of boars and the method of their castration on the weight before slaughter. To carry out the experiment, 30 surgically and 30 immunocastrated male pigs weighing 100, 110 and 120 kg were taken and reared under the same conditions in an industrial pig complex. After completion, the pigs were slaughtered and the carcasses were cut into cuts. The weight and content of the cuts were examined separately in the shoulder-scapular third, back-loin third and pelvis-femoral third of all groups of experimental pigs. According to the experimental results, the influence of the castration method on the weight and content of meat cuts, bacon pieces and bones in the shoulder-scapular third was found to be in favour of the immunocastrated boars. The weight and content of meat pieces in the posterior lumbar third were the same in surgically and immunocastrated boars, with the exception of bones. Meat pieces, bacon and bones in the pelvic femoral third of the pelvis did not differ between surgically and immunocastrated male pigs. Increasing the weight before slaughter from 100 to 120 kg had a positive effect on the weight and meat piece content of the piglets in both castration methods.

Key words**:** *meat cuts, pig carcass, lard, loin, belly*

INTRODUCTION

Immunological castration of boars is already widely used in pig farming, but its use is not yet as widespread as surgical castration [33, 42]. In addition to the influence of factors such as feeding factor [31, 32], genotype [29], pre-slaughter weight [43], transport conditions

[34] and pre-slaughter pig treatment [15], the method of castration is another factor influencing the quality of pork. The main purpose of pig castration is to eliminate the unpleasant "boar smell". It is known that the unpleasant smell of pork derived from wild boar can be minimised by reducing the concentrations of androstenone and skatol compounds in the fat and muscle tissue. Usually, the elimination of thissmell is achieved by castration [6] or without castration using methods of genetic selection, the addition of special feed additives and technological aspects of rearing and fattening [38]. However, it is known that the most common methods of eliminating "boar smell" worldwide are surgical castration with or without anaesthesia and analgesia, and immunological castration [40]. Raising pigs without castration is common in the UK, Ireland, Spain and Portugal. In the Netherlands, 80% of boars are reared without castration and 20% are castrated. Nineteen other countries in Central and Western Europe castrate about 80% of their pig population [17]. On average, the proportion of surgically castrated pigs in EU countries was 97.3% and the proportion immunocastrated was 2.7% [18]. However, it has been reported that surgical castration of boars in the European Union was performed with anaesthesia in 5%, with analgesia in 41% and without anaesthesia or analgesia in 54% [2]. Given the significant prevalence of surgical castration in the European Union, a strong initiative to end it has long been growing in society [8]. Surgical castration of male piglets without analgesia or anaesthesia is considered welfare-relevant and humane, and animal welfare would improve if it were performed with analgesia [44]. However, there is evidence that general or local anaesthesia during surgical castration in pigs causes additional health problems later on [10]. An alternative is therefore immunological castration [11, 21], which consists of two inoculations against gonadotropin-releasing hormone (GnRH) and uses the pig's immune system to achieve an effect at the level of surgical castration. It makes it possible to solve the problem of "boar smell" by minimising pain and aggressive [5] and sexual behaviour [11] characteristic of boars reared without castration.

Most farmers are very sceptical about immunocastration, although its effectiveness has been scientifically proven. Among consumers, three main factors influence the spread and acceptance of immunocastration in society. In particular, sensitivity to animal welfare and the high quality of pork without the "boar smell" contribute to the spread of immunocastration. But the question of the safety of pork from immunocastrated male animals is a cause for concern [28]. Farmers' fears about the widespread introduction of immunocastration are not unfounded, as not all pigs respond equally to the introduction of the vaccine. Some animals do not respond to the vaccine (so-called "non-responders") due to poor immunological response or technically incorrect vaccination [26]. The number of such pigs in the total population is 1-3%. Immunocastration reliably prevents the occurrence of "boar smell" only if farmers follow the manufacturer's recommendations for vaccination methods and dates [49]. Consumers generally rate the smell of meat and fat samples from immunocastrated boars better than those from surgically castrated boars [40]. Studies show that immunocastration of pigs improves some growth indicators and the quality of pig carcasses and meat [13]. Similar published data describe that the method of castration had no effect on the weight of major carcass cuts, with the exception of higher breast weight, leg content and weight in immunocastrated compared to surgically castrated pigs [3].

Immunocastrated pigs show intense fat deposition and consequently an increase in fat weight after immunisation [39], which leads to fattening the pigs to a higher weight before slaughter, which also affects the indicators of their carcasses [41]. At the same time, when the slaughter weight increases from 100 to 140 kg, the relative proportion of all meat parts in the carcasses decreases from 55.9 to 51.0% and the proportion of bacon increases from 27.4 to 33.5%. The content of high quality meat parts in carcasses decreases to 42.1%, which has a significant impact on the

quality and price of pork [47]. An important reserve for increasing pork production is the higher weight of animals before slaughter. However, the question of the optimal weight condition of pigs for slaughter remains unresolved. Research has shown that fattening pigs to a high weight (120-130 kg) leads to an increase in feed costs per unit of growth and an increase in production costs. Slaughtering pigs at a lower weight helps to reduce feed costs and increase carcass production [7]. Published data indicate a significant increase in average daily gain after the second vaccination in immunocastrated pigs [30], resulting in a rapid increase in carcass fat content [16]. To curb the excessive fat content of carcasses from immunocastrated boars, some researchers attempted to restrict feeding. However, this had no significant effect on fat deposition and carcass leanness [14]. The result of such restriction of feeding of immunocastrates was only an increase in aggressiveness of the boars during fattening [45] or before slaughter [4]. However, there is a report of an effect of immunocastration resulting in lower carcass fat content compared to surgically castrated pigs [36, 22]. In addition, some researchers indicate that the castration method has no effect on the weight and percentage of carcass meat, except for the index of fat thickness in immunocastrated pigs, which was higher than in surgically castrated animals [35]. As stated in recent scientific works, the weight of the rear part of the carcass depended on 74.5% of the pre-slaughter weight and 6.07% on the castration method, and the weight of the loin depended on 39.7% on the pre-slaughter weight of pigs, on 5.78% on the method castration and by 9.46% depended on the interaction of the factors of castration method and pre-slaughter weight [1]. In addition, the relationship between pre-slaughter weight and androstenone content was demonstrated. It was found that with increasing live weight, androstenone levels increase from 0.60 μg g^{-1} in 105-kilogramme boars to 1.02 μg g^{-1} in 130-kilogramme animals [19].

Thus, both the castration method and the weight before slaughter influence the weight of the meat parts of the carcass. The use of the method of immunocastration of pigs accelerates their growth, leading to an increase in weight before slaughter, which probably increases the influence of this factor on the weight indicators of large-piece semi-finished products. The study of the dependence of the slaughter performance of pigs on the influence of the castration method at different weights before slaughter is of high relevance, since immunocastration is an alternative veterinary method that is still gaining widespread use among pork producers. The purpose of the experiment is to evaluate how immunocastration, surgical castration and mass before slaughter affected the slaughter characteristics in three parts of pig carcasses.

MATERIALS AND METHODS

Hybrid boars of F_1 sows (Irish Landrace × Yorkshire) and Max-Gro terminal boars were used to study the influence of castration method and weight before slaughter on the weight and percentage of meat cuts. The pigs were kept in Globinsky Pig Complex LLC, Poltava region, Ukraine.

Two hundred boars were selected to participate in the experiment. After the boars were born, two heads were taken from the nest by a sow with the same physiological development and weight. One of the two pigs removed from the sow was marked with a red plastic indicator and the other with a blue plastic indicator, which also bore an individual number.

One hundred boars with red indicators were surgically castrated on the second day of life. The other hundred analogues with blue indicators remained "intact" as they underwent immunological castration. For immunological castration, the vaccine Improvak was used, which was injected intramuscularly in a volume of 2 ml into the uncastrated piglets at 77 days of age and again at 125 days of age.

During fattening, 50 pigs were kept under technologically identical conditions in pens with an area of 40 m^2, the floor of which was completely slit and made of concrete. Feeding was 10 times a day with liquid complete feed

mixtures, which had a ratio of dry feed to liquid portion of 1 : 3. The diet comprised feed produced at the Weda feed farm (Dammann & Westerkamp GmbH, Austria) on the premises of the pig complex, containing: wheat grain 35.6%, maize grain kibbled 19.2%, soybean seed meal solvent extracted 13.6%, sorghum grain 11.8%, cereals, screenings 10.2%, sunflower seed meal mechanically extracted 8.6%, wheat bran 1.0%.

The nutritional value of the feed contained the necessary micro and macro elements and vitamins required for normal fattening of pigs between 30 and 120 kg (Table 1).

Table 1. Nutritional value of feed for fattening

Indicator	Value
Protein content,%	18.5
Lysine content,%	1.0
Oil content,%	2.9
Fiber content,%	4.4
Calcium content,%	0.62
Assimilable phosphorus content,%	0.28
Total phosphorus content,%	0.59
Vitamin A content, IU kg^{-1}	10,000
Vitamin D content, IU kg^{-1}	2,000
Vitamin E content, IU kg^{-1}	100
Biotin content, μg kg^{-1}	100
Assimilable energy, MJ kg^{-1}	13.63

Source: own calculations.

The pigs were marked with a spray on the back skin after weighing, which divided them into 3 groups of 30 pigs each weighing 100, 110 and 120 kg (for surgically castrated) and into 3 groups of 30 pigs each weighing 100, 110 and 120 kg (for immunologically castrated). Based on Globinsky Meat Factory LLC, Poltava region, Ukraine, the animals in each group were re-weighed after a 24-hour starvation period and slaughtered according to ISO 23781:2021 [24]. After slaughter, the carcasses were weighed and then chilled at a temperature of 2 to -4 oC for 24 hours. At the end of the chilling period, the carcasses were divided into three anatomical parts: cervical-scapular, dorsal-lumbar and pelvic-femoral. Each anatomical part was cut into pieces of meat, bacon, bone and skin using generally accepted methods according to ISO 3100-1 [25]. During the experiment, the slaughter qualities of the boars were examined, including the weight and the content of the most valuable large pieces in the three specified parts of the carcass.

The statistical analysis of the experimental data series included the estimation of the mean value of the indicator, the determination of the error of the standard value and the determination of the standard deviation. The significance level of the discrepancy ($p \leq 0.01$) of the slaughter indicator values was determined using Student's t-test. All statistical analyses and calculations were performed in Microsoft Office Excel 2010.

European legislation on the humane treatment of experimental animals was taken as the basis for setting up the experiment to avoid the suffering of pigs [12].

RESULTS AND DISCUSSIONS

Examination of the slaughter qualities of the shoulder-scapular part of the carcass revealed a 4.80 kg or 21.05% higher weight ($p < 0.01$) in surgically castrated boars weighing 120 kg before slaughter compared to 100 kg in surgically castrated boars. Neck meat weight was 0.80 kg or 19.51% higher in surgically castrated boars weighing 120 kg compared to boars weighing 100 kg ($p < 0.001$) and 0.70 kg or 16.67% higher compared to boars weighing 110 kg ($p < 0.001$). The neck bone of surgically castrated pigs was significantly heavier at 120 kg, both compared to 100 kg boars by 0.50 kg or 25.00% ($p < 0.001$) and compared to 110 kg boars by 0.30 kg or 13.64% ($p < 0.01$). The value of the neck index in surgically castrated pigs was highest in heavy pigs (120 kg) compared to light pigs (100 kg) by 0.10 kg or 6.67% ($p < 0.05$). In 120 kg surgically castrated pigs, shoulder bone weight was 0.40 kg or 23.53% higher than in 100 kg pigs ($p < 0.05$), although no significant difference was found in shoulder blade meat weight between the groups. In 120 kg surgically castrated pigs, the value of the indicator for lard with shoulder exceeded the same indicator in 100 kg pigs by 0.50 kg or 29.41% ($p < 0.01$) and by 0.40 kg or 22.22% in 110 kg analogues ($p < 0.01$). Lard with skin was also 0.60 kg or 13.96% heavier in 120 kg

surgical castrates than in 100 kg animals. No significant difference was found between surgically castrated boars weighing 100, 110 and 120 kg for other indicators of meat weight in the shoulder-scapular third of the carcass (Table 2).

The weight of the scapular part of heavyweight pigs was higher than that of light (100 kg) counterparts by 4.70 kg or 20.26% ($p < 0.05$). Also, the weight of the neck of pigs with 120 kg of pre-slaughter weight was probably higher than that of lighter peers by 0.60 kg or 13.95 ($p<0.05$). Immunocastrated pigs slaughtered at 120 kg were superior to both 100 kg and 110 kg animals in terms of neck bone weight by 0.60 kg or 31.58% ($p <0.001$). The output of neck single grade pork in immunocastrates weighing 120 kg was higher than in their peers slaughtered at 100 and 110 kg, relative to each group.

Table 2. Weight of large-piece semi-finished products in the shoulder-scapular third of the carcass, n=30

Pre-slaughter weight, kg	**100 kg**	**110 kg**	**120 kg**
Indicator	**Surgically castrated**		
Weight of the shoulder-scapular third, kg	22.8 ± 1.25^{aA}	24.5 ± 1.10^{bA}	27.6 ± 1.01^{bA}
Neck with bone, kg	7.6 ± 0.55^{aA}	7.9 ± 0.43^{aA}	9.1 ± 0.75^{aA}
Neck meat, kg	4.1 ± 0.12^{aA}	4.2 ± 0.09^{aA}	4.9 ± 0.13^{bA}
Neck bone, kg	2.0 ± 0.09^{aA}	2.2 ± 0.08^{aB}	2.5 ± 0.06^{bA}
Neck single grade pork, kg	1.4 ± 0.04^{aA}	1.5 ± 0.04^{abA}	1.6 ± 0.05^{bA}
Shoulder blade meat, kg	7.9 ± 0.51^{aA}	8.4 ± 0.63^{aA}	9.5 ± 0.72^{aA}
Shoulder bone, kg	1.7 ± 0.13^{aA}	1.9 ± 0.11^{abA}	2.1 ± 0.12^{bA}
Shoulder single grade pork, kg	1.7 ± 0.15^{aA}	1.8 ± 0.10^{aA}	2.0 ± 0.06^{bA}
Lard with skin, kg	3.9 ± 0.29^{aA}	4.3 ± 0.33^{abA}	4.9 ± 0.21^{bB}
Indicator	**Immuno castrated**		
Weight of the shoulder-scapular third, kg	23.2 ± 1.13^{aA}	24.8 ± 1.39^{abA}	27.9 ± 1.44^{bA}
Neck with bone, kg	8.0 ± 0.84^{aA}	8.1 ± 1.10^{aA}	9.5 ± 0.95^{aA}
Neck meat, kg	4.3 ± 0.13^{aA}	4.4 ± 0.18^{abA}	4.9 ± 0.20^{bA}
Neck bone, kg	1.9 ± 0.07^{aA}	1.9 ± 0.08^{aA}	2.5 ± 0.10^{bA}
Neck single grade pork, kg	1.7 ± 0.04^{aB}	1.7 ± 0.06^{aB}	2.0 ± 0.05^{bB}
Shoulder blade meat, kg	8.2 ± 0.65^{aA}	8.8 ± 0.50^{abA}	10.1 ± 0.43^{bA}
Shoulder bone, kg	1.8 ± 0.14^{aA}	1.9 ± 0.09^{abA}	2.6 ± 0.05^{bB}
Shoulder single grade pork, kg	1.8 ± 0.11^{aA}	2.1 ± 0.09^{bB}	2.1 ± 0.12^{abA}
Lard with skin, kg	3.8 ± 0.22^{aA}	3.7 ± 0.18^{aA}	3.9 ± 0.16^{aA}

Different lowercase letters (a, b) indicate statistical difference different weight categories of one method of castration (lines) at the level of $P <0.05$. Different capital letters (A, B, C, D) indicate statistical difference between different methods of castration of the same weight category (columns)at the level of $P <0.05$
Source: own calculations.

The shoulder meat of immunocastrates was also 1.90 kg or 23.17% heavier in 120 kg boars than in their 110 kg counterparts ($p <0.05$). Heavy immunocastrates (120 kg) had a higher shoulder bone weight of 0.80 kg or 44.44% ($p <0.001$) than light immunocastrates (100 kg) and 0.70 kg or 36.84% higher ($p <0.001$) than immunocastrates with average pre-slaughter weight (110 kg). Single-grade pork from the shoulder was 0.30 kg or 16.67% heavier in immunocastrated boars of 110 kg than in immunocastrated boars of 100 kg ($p <0.05$). Statistically significant differences between the weights of other cuts of meat were not found in immunocastrated pigs regardless of weight.

It was found that the weight of the neck bone in surgically castrated boars of 110 kg was 0.30 kg or 13.64% ($p <0.05$) higher than in immunocastrated boars of 110 kg, and in surgically and immunocastrated boars of 100 and 120 kg the difference was not present according to this indicator. Both the weight of pork of the same grade and the weight of the humerus were significantly higher in pigs that were immunocastrated at pre-slaughter weight of 100, 110 and 120 kg, except for light and medium weight pigs. The weight of pig shoulder with skin was 0.30 kg or 16.67% higher in immunocastrates weighing 110 kg compared to surgical castrates weighing 110 kg ($p <0.05$), while there was no difference in

the value of this indicator in piglets of both castration methods in the 100 and 120 kg weight classes. The weight of lard with skin was 1.0 kg or 20.41% higher in surgically castrated pigs weighing 120 kg than in immunocastrated pigs weighing 120 kg ($p < 0.01$). For carcasses of boars weighing 100 and 110 kg for both castration methods, this indicator did not show statistically significant differences.

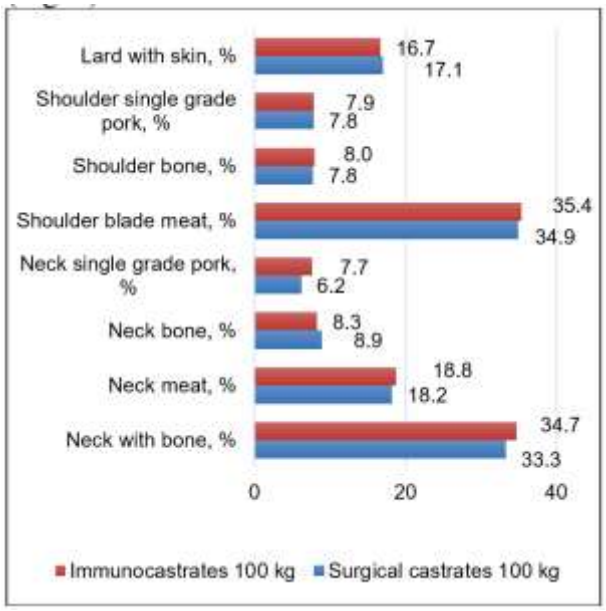

Fig. 1. The content of meat cuts in the shoulder-scapular third of the carcass of 100 kg pigs
Source: own calculations.

In lightweight pigs of 100 kg, the share of single-type necks was higher by 1.5% in immunocastrated compared to analogs that underwent surgical castration (Fig. 1).

Estimation of the share of cuttings of large-sized semi-finished products in the shoulder-scapular third of the carcass of 110 kg male pigs revealed a 1.5% and 1.0% higher content of shoulder single grade pork and neck single grade pork in immunocastrates and a 1.2% higher content of neck bone in surgical castrates (Fig. 2).

Heavyweight surgical castrates had a higher meat chunk content in the shoulder compared to surgically castrated counterparts by 1.6% shoulder meat and 1.2% neck pork of the same type.

At the same time, surgically castrated piglets had a higher lard with skin content of 3.7% in this part of the carcass (Fig. 3).

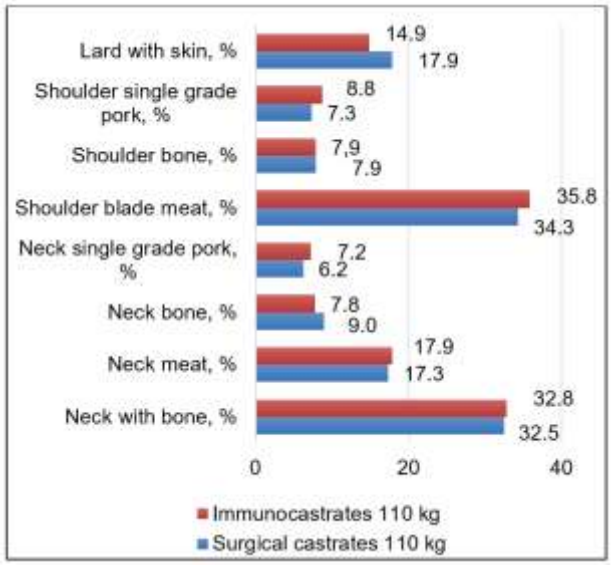

Fig. 2. The content of meat cuts in the shoulder-scapular third of the carcass of 110 kg pigs
Source: own calculations.

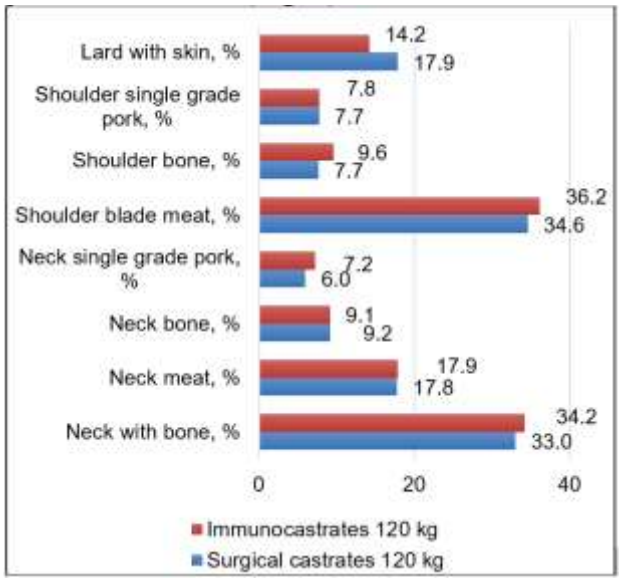

Fig. 3. The content of meat cuts in the shoulder-scapular third of the carcass of 120 kg pigs
Source: own calculations.

In surgically castrated pigs, the weight of the back- lumbar third of the carcass was 6.10 kg or 25.52% ($p < 0.05$) higher in 120 kg pigs compared to 100 kg pigs and 4.30 kg or 16.73% ($p < 0.05$) higher compared to 110 kg pigs (Table 3). In the 120 kg surgically castrated animals, the loin bone-in was also 2.6 kg or 23.64% heavier ($p < 0.05$) than in the 100 kg animals. Belly bone-in was also 3.6 kg or 28.13% heavier in heavy (120 kg) surgically castrated animals compared to light (100 kg) animals ($p < 0.05$). Lumbar bone of loin weight was 0.2 kg or 9.52% higher in 120

kg surgically castrated pigs compared to 100 kg pigs ($p < 0.01$). Heavy surgical castrates outnumbered their lighter counterparts by 3.3 kg or 30.28% in abdominal weight, as well as peers with an average weight of 2.3 kg or 19.33%.

Table 3. Weight of meat cuts in the back-lumbar third of the carcass, n=30

Pre-slaughter weight, kg	**100 kg**	**110 kg**	**120 kg**
Indicator	**Surgically castrated**		
Weight of back-lumbar third, kg	23.9±1.74^{aA}	25.7±1.43^{aA}	30.0±1.32^{Ba}
Loin bone-in, kg	11.0±0.81^{aA}	11.7±0.75^{abA}	13.6±0.77^{Ba}
Belly bone-in, kg	12.8±1.03^{aA}	14.0±1.10^{abA}	16.4±1.12^{Ba}
Eye of loin, kg	5.5±0.31^{aA}	5.7±0.29^{aA}	6.3±0.93^{Aa}
Bone of loin, kg	2.1±0.03^{aA}	2.2±0.05^{abA}	2.3±0.05^{Ba}
Belly, kg	10.9±0.98^{aA}	11.9±0.68^{aA}	14.2±0.61^{Ba}
Bone of belly, kg	1.9±0.04^{aA}	2.0±0.05^{aA}	2.0±0.05^{Aa}
Single grade meat, kg	0.3±0.01^{aA}	0.3±0.01^{aA}	0.4±0.02^{Ba}
Spine lard with skin, kg	3.0±0.52^{aA}	3.5±0.48^{abA}	4.6±0.40^{Ba}
Indicator	**Immuno castrated**		
Weight of back-lumbar third, kg	23.6±1.55^{aA}	25.9±1.33^{abA}	29.6±1.26^{Ba}
Loin bone-in, kg	10.8±0.82^{aA}	11.9±0.91^{abA}	14.0±1.11^{Ba}
Belly bone-in, kg	12.7±1.09^{aA}	13.9±1.13^{aA}	15.5±1.03^{Aa}
Eye of loin, kg	5.4±0.80^{aA}	5.8±0.55^{aA}	6.6±0.99^{Aa}
Bone of loin, kg	2.2±0.04^{aA}	2.3±0.06^{aA}	2.6±0.05^{Bb}
Belly, kg	10.7±0.57^{aA}	11.9±0.81^{abA}	13.3±0.76^{Ba}
Bone of belly, kg	2.0±0.06^{aA}	2.0±0.05^{aA}	2.2±0.06^{b*B}
Single grade meat, kg	0.3±0.01^{aA}	0.3±0.01^{aA}	0.4±0.01^{Ba}
Spine lard with skin, kg	2.9±0.30^{aA}	3.4±0.24^{aA}	4.3±0.38^{Ba}

Different lowercase letters (a, b) indicate statistical difference different weight categories of one method of castration (lines) at the level of $P < 0.05$. No the same capital letters indicate statistical difference between different columns at $P < 0.05$
Source: own calculations.

The weight of single-grade meat in the back-lumbar third of the carcass was significantly higher in 120 kg surgically castrated male pigs and equally exceeded the value of this indicator in 100 and 110 kg pigs by 0.1 kg or 33.33% ($p < 0.001$). Similarly, the weight of spine lard with skin was 1.6 kg or 53.33% higher in surgically castrated boars weighing 120 kg than in 100 pigs ($p < 0.05$).

The weight of the back- lumbar third of the carcass in immunocastrated boars was 6.0 kg or 25.42% higher in animals weighing 120 kg compared to lighter conspecifics weighing 100 kg ($p < 0.01$). It was found that the weight of the loin bone-in was also 3.2 kg or 29.63% higher in 120 kg immunocastrated boars compared to 100 kg animals ($p < 0.05$). The weight of the loin bone was 0.4 kg or 18.18% ($p < 0.001$) and 0.3 kg or 13.04% ($p < 0.01$) higher in 120 kg immunocastrated boars compared to 100 and 110 kg animals, respectively.

Belly weight was 2.6 kg or 24.3% higher in heavy (120 kg) immunocastrated male pigs compared to light (100 kg) pigs ($p < 0.05$). Bone of belly weight was also 0.20 kg or 10.00% ($p < 0.05$) higher in 120 kg immunocastrated male pigs compared to 100 and 110 kg pigs. The weight of single-grade meat from the back- lumbar third of the carcass was 0.1 kg or 33.33% higher in 120 kg immunocastrated piglets compared to 100 and 110 kg conspecifics ($p < 0.001$). A higher weight of spine lard with skin was observed in 120 kg immunocastrated pigs compared to their pre-slaughter counterparts weighing 100 kg, by 1.4 kg or 48.28% ($p < 0.01$).

Heavyweight immunologically castrated males had a higher weight of loin bone in the back third of the carcass compared to peers who underwent surgical castration by 0.3 kg or by 13.04%. Bone of belly weight was 0.20 kg or 10.00% higher in 120 kg immunocastrated boars than in 120 kg surgically castrated boars ($p < 0.05$). Pigs of different weight categories did not differ in the slaughter qualities of the back third of the carcass.

Also, leggy males, which were castrated by different methods, did not have differences in the indicators of meat offcuts in the rear third of the carcass (Fig. 4).

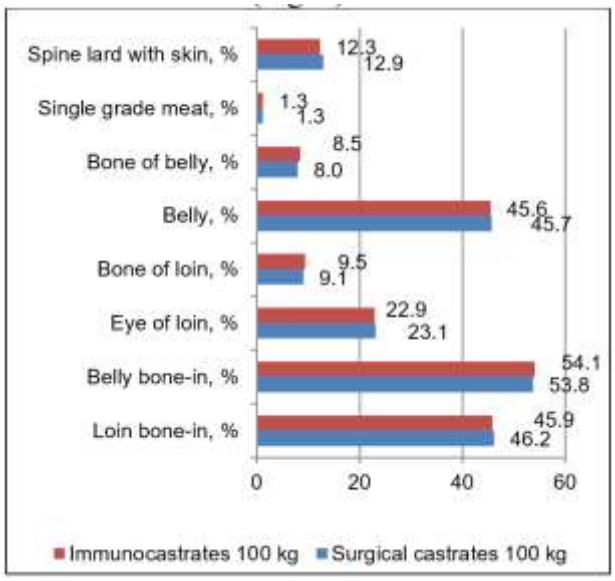

Fig. 4. The content of meat cuts in the back-lumbar third of the carcass of 100 kg pigs
Source: own calculations.

After both surgical and immunological castration of 110 kg pigs, statistically equal values were determined for the indicator content of the meat pieces from the back-lumbar part of the carcass (Fig. 5).

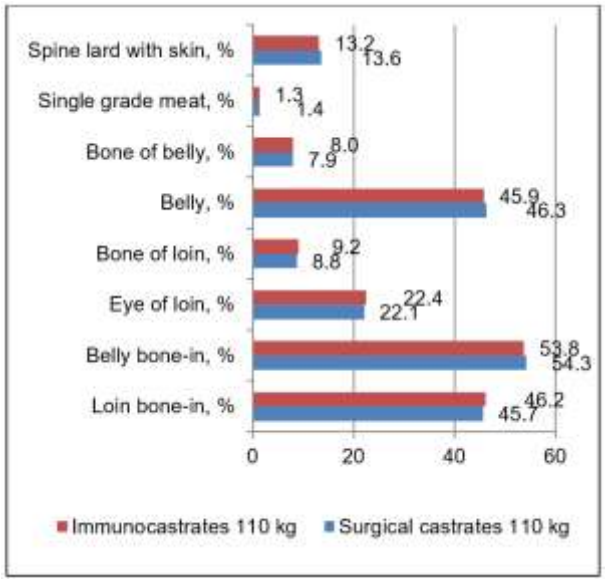

Fig. 5. The content of meat cuts in the back-lumbar third of the carcass of 110 kg pigs
Source: own calculations.

Immunocastrated pigs weighing 120 kg before slaughter had 0.6% and 1.2% higher content bone of belly and bone of loin compared to surgically castrated pigs, while there was no difference in the content of the other components in the back- lumbar third of the pig carcasses of this weight group (Fig. 6).

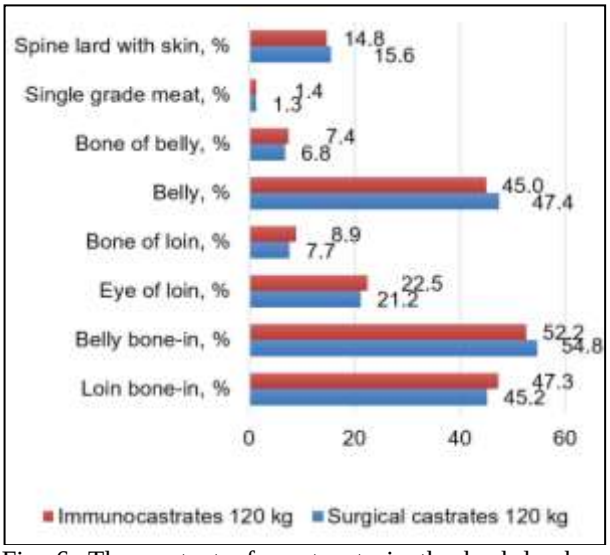

Fig. 6. The content of meat cuts in the back-lumbar third of the carcass of 120 kg pigs
Source: own calculations.

The weight of the pelvic-femoral third was 5.3 kg or 21.81% higher in surgically castrated boars in the heavy pig group (120 kg) than in their counterparts weighing 100 kg ($p < 0.05$).
Immunocastrated piglets weighing 120 kg differed by the greatest leg weight by 3.0 kg or 18.52% ($p < 0.01$) compared to their pre-slaughter counterparts weighing 100 kg (Table 4). The remaining cuts of meat from surgically castrated boars did not differ in weight between 100, 110 and 120 kg pigs.
The weight of the pelvic-femoral third in immunocastrated pigs was 5.1 kg or 20.90% higher in heavy boars (120 kg) than in light conspecifics (100 kg) ($p < 0.05$).
Similarly, for boneless leg weight, the 120 kg immunocastrates were superior to the 100 kg and 110 kg analogues in leg boneless weight by 4.0 kg or 25.81% ($p < 0.001$) and 2.5 kg or 14.71% ($p < 0.05$), respectively.
It was established that the bone of leg was heavier in immunocastrates weighing 120 kg before slaughter compared to peers weighing 100 kg before slaughter ($p < 0.05$).
Immunocastrated pigs, regardless of their weight, had the same large meat offcuts from the rear third. The weight of meat offcuts in

the hindquarters of pigs subjected to different methods of castration also did not differ. And the content of meat offal had no statistically significant difference in light-weight, medium-weight and heavy-weight pigs. (Fig. 7, 8, 9).

Table 4. Weight of meat cuts in the pelvic-femoral third of the carcass, n=30

Pre-slaughter weight, kg	**100 kg**	**110 kg**	**120 kg**
Indicator	**Surgically castrated**		
Weight of pelvic-femoral third, kg	24.3±1.48^{aA}	26.7±1.12^{abA}	29.6±1.41^{Ba}
Leg boneless, kg	16.2±0.77^{aA}	17.4±0.64^{abA}	19.2±0.65^{Ba}
Bone of leg, kg	2.2±0.14^{aA}	2.4±0.15^{aA}	2.6±0.14^{Aa}
Tail, kg	0.3±0.01^{aA}	0.3±0.01^{aA}	0.3±0.01^{Aa}
Single grade pork, kg	1.2±0.08^{aA}	1.3±0.07^{aA}	1.4±0.08^{Aa}
Fat pork with skin, kg	4.2±0.56^{aA}	5.2±0.42^{aA}	5.7±0.53^{Aa}
Indicator	**Immuno castrated**		
Weight of pelvic-femoral third, kg	24.4±1.35^{aA}	26.2±1.22^{abA}	29.5±1.32^{Ba}
Leg boneless, kg	15.5±0.66^{aA}	17.0±0.80^{aA}	19.5±0.73^{Ba}
Bone of leg, kg	2.4±0.12^{aA}	2.5±0.13^{abA}	2.8±0.12^{Ba}
Tail, kg	0.3±0.01^{aA}	0.3±0.01^{aA}	0.3±0.01^{Aa}
Single grade pork, kg	1.4±0.09^{aA}	1.5±0.09^{aA}	1.5±0.07^{Aa}
Fat pork with skin, kg	4.6±0.49^{aA}	4.9±0.33^{aA}	5.2±0.32^{Aa}

Different lowercase letters (a, b) indicate statistical difference different weight categories of one method of castration (lines) at the level of P <0.05. Different capital letters (A, B, C, D) indicate statistical difference between different methods of castration of the same weight category (columns)at the level of P <0.05
Source: own calculations.

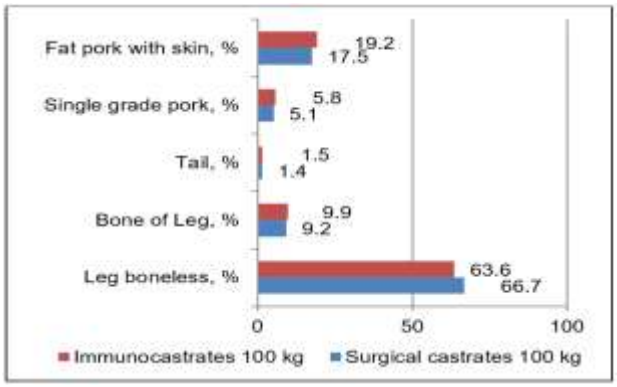

Fig. 7. The content of meat cuts in the pelvic-femoral third of the carcass of 100 kg pigs
Source: own calculations.

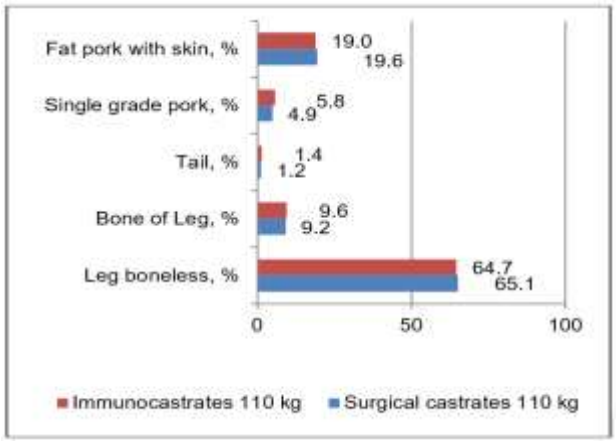

Fig. 8. The content of meat cuts in the pelvic-femoral third of the carcass of 110 kg pigs
Source: own calculations.

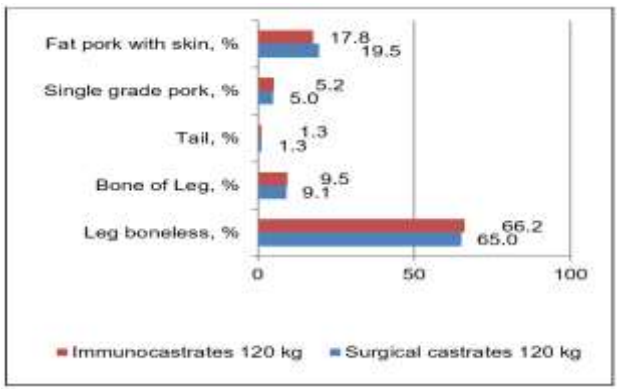

Fig. 9. The content of meat cuts in the pelvic-femoral third of the carcass of 120 kg pigs
Source: own calculations.

Similar to conclusions [1] about the influence of mass before slaughter on the weight of the back third of the carcass by 74.4% and on the weight of the loin, we obtained similar results of the influence of the factor characteristic on the studied slaughter qualities of the carcass. Also similar to the reports of similar studies about the different mass of the rear third of the carcass by 21.8% and by 20.0% in light-weight and heavy-weight pigs, both in immunologically castrated males and in surgically castrated ones, we reached similar results in our experiment. However, in our experiment, no dependence was found between the pre-slaughter weight and the loin

portion, which contradicts the reports on its possible existence [27] at the level of 0.7% for the specified part of the meat cut, but agrees with another opinion [46] on the absence of such an effect not only on the weight of the loin but also on the weight of the neck meat, with which, however, our results do not agree. In contrast to the published manuscript [3], which reported the influence of castration method on carcass weight and percentage of belly meat, we also found no correlation between castration method and indicators of weight and percentage of belly meat. However, in our study, slaughter weight reliably influenced this indicator only in surgically castrated pigs.

The statement [3, 16, 35, 39] about more intense fat deposition and consequently an increase in lard weight after immunisation was not confirmed in our experiment. Instead of what was said [37] about the lack of influence of the castration method on slaughter qualities, we found a higher mass of fat in the shoulder part of the carcass in heavy-weight surgically castrated males compared to counterparts that underwent immunological castration, which is positively correlated with the results of the experiment [22, 36]. However, similar to the findings [47] on the increase in lard weight when increasing the pre-slaughter weight of boars from 100 to 140 kg, we found a similar increase in lard weight when increasing the pre-slaughter weight from 100 to 120 kg, but exclusively in the shoulder-scapular part of the carcass in surgically castrated pigs as well as in immunocastrated male pigs and in the back-lumbar part of the carcass in immunologically castrated pigs. We had somewhat contrary data in contrast to the publications [35, 37], which talked about the lack of influence of the castration method on the weight and proportion of carcass meat parts, as we found a reliable influence of the castration method on the weight and proportion of neck single grade pork, shoulder single grade pork and shoulder blade meat in surgically and immunocastrated boars.

Previously published scientific papers [9] have also pointed out that there is no reliable dependence between castration method and the weight of the neck bones, shoulder bones, bones of loin and bones of belly in the carcass, but we found that both castration method and pre-slaughter weight were reliably related to these indicators. Thus, in our experiment, neck bones were found to be heavier in surgically castrated boars and the bones of loin and abdominal bones were heavier in immunocastrated boars, which is consistent with the conclusions of other authors [20, 23] who also identified heavier bones in immunocastrates.

Considering the report [48] on the absence of any influence of castration method on pig carcass parameters, we can state the opposite, that there was an influence, but it was selective and not complete. The influence of the castration method in boars was reflected to a greater extent on the front and middle parts of the carcass than on the rear.

CONCLUSIONS

Immunocastrated pigs showed an advantage in terms of mass and proportion of neck, scapula and scapular meat relative to surgically castrated counterparts. But males that were castrated surgically had a higher content of bones in the third of the shoulder and fat and skin.

Immunocastrates also had greater vagus and posterior third lumbar and abdominal bone content than surgically castrated counterparts. The meat cuts in the pelvic-femoral thirds of the carcass showed no significant difference in weight and content in boars with surgical and immunological castration methods. Taking into account the influence of weight before slaughter, it was found that the weight and content of most meat cuts in the three parts of the carcass of 120 kg boars outweighed their lighter 100 and 110 kg counterparts for both castration methods. Therefore, immunocastration of boars ensured a greater weight of meat pieces. The combination of immunocastration and an increase in the slaughter weight of boars up to 120 kg made it possible to obtain more meat cuts compared to surgically castrated boars of the same weight.

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