Bulgarian Journal of Agricultural Science, 25 (No 2) 2019, 403–409

Biological and economic aspects of immunological castration in comparison with traditional (surgical) method

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Abstract

Povod, M., Lozynska, I., & Samokhina, E. (2019). Biological and economic aspects of immunological castration in comparison with traditional (surgical) method. *Bulgarian Journal of Agricultural Science*, *25*(2), 403–409

Pork farming practices involve castration of pigs as a method of obtaining high quality products. Most often, this is due to the fact that during sexual maturation the animal organism produces hormones that lead to aggressive behavior of animals and as a consequence of stressful events which can be a factor of slowing down the growth process. Immunological form of cessation of sexual activity animal is more humane, but because of high prices is not available for most small farmers. Compared to the standard procedure of castration, immunological method is temporarily blocked gland to produce steroids. Vaccination takes place at a later age than surgical castration, which allows pork producers to realize the potential of non-castrated animals during rearing and to monitor the presence of the meat smell. The performed research finally confirmed the benefits of using the immunological castration in comparison with traditional surgical method:

During the fattening period, immunological castrates had 10 g higher daily average gain, and at the end of the fattening period, they achieved a live weight of 3.9 kg higher than the castrated surgical boars.

During the fattening period, immunological castrates daily eaten an average of 2.50 kg of feed, which is 0.12 kg less compared to surgical castrate.

Due to our opinion, immunological castrates had a better 0.20 kg feed conversion compared to surgical castrated.

The cost of 1 kg of pork by slaughtering of immunological castrated animals is 8.9% lower compared to the cost of meat of surgical castrated.

After the dissection from immunological castrated animals more meat and less fat were obtained. Revenue from sales of commercial products from immunological castrates is higher by 2.3%.

Keywords: pork production; surgical castration; immunological castration

Introduction

Pork farming practices involve castration of pigs as a method of obtaining high quality products. Most often, this is due to the fact that during sexual maturation the animal organism produces hormones that lead to aggressive behavior of animals and as a consequence of stressful events which can be a factor of slowing down the growth process. An even more significant factor is the producing by the non-shredded knuckles the specific substances clathol and androstenol which are transferred in specific odor to the meat and even more to the bacon. As a result, due to the unpleasant smell of meat, animals that have not lost their reproductive capacity will be unfit for consumption.

The main forms of castration include surgical (operational) method, chemical method and immunological method.

The American Veterinary Medical Association (AVMA, 2013) considers that castration really helps to maintain the quality of meat and recommends surgical castration in period 5 days before the weaning piglets from a sow. In European

countries, surgical castration of piglets in recent years is carried out at age of 2-4 days, which reduces the pain of the animal and minimizes the negative effects for further productivity.

But the more popular in Europe is the immunological type of pig's castration because of its humanity. A number of interesting studies have been conducted in European countries concerning pig's castration. For example, the McDonald's fast food chain expressed reluctance to sell products with containing castrated pig's meat. This was done to deprive animals suffering from surgery in the future. Next European and World trade networks have joined this initiative: Cora, Colruyt, Lidl, Carrefour, Delhaize, Makro and Aldi.

Immunological form of cessation of sexual activity animal is more humane, but because of high prices is not available for most small farmers. Compared to the standard procedure of castration, immunological method is temporarily blocked gland to produce steroids. Vaccination takes place at a later age than surgical castration, which allows pork producers to realize the potential of non-castrated animals during rearing and to monitor the presence of the meat smell.

For the first time this method was used in 1998 in Australia. After injection, the body of the animal is suppressed the synthesis of gonadotropin through synthesis of antigen that produced by the immune system of animals (Gonadotrophin Realizing Factor – GnRF).

After injection of the dose of vaccine for immunological castration (in this case, it is an "Improvak" produced by Zoetis Australia Research & Manufacturing, Pty. Ltd.), the animal's body exhibits a high level of specific anti-gonadotrophin releasing hormone that provides development and function testicons in the buds. The highest level of antibodies is produced by the body at 10-14 days after the injection of the second dose of the drug.

Materials and Methods

The claim of early pig's castration has a scientific justification. For example, experiments have shown that 2-week old piglets in the castration process exhibit fewer signs of pain than 7-week-old piglets. As a result of another study, it was found that piglets, castrated at the age of 1 day before weaning, grew slower than castrated in age of 14 days' ones.

In 1994, a similar study was conducted and it was determined by the experts that there was no difference in the growing process of piglets castrated at the age of 1 day before weaning and on the 10th day (Denver, 2017).

All these researches were supported by the practice of farmers, and as a result it has been found that the process of piglets castrated is best at the age of 4-14 days. Castration after this age allows the piglets to receive a certain dose of colostrum and get used to the "schedule" of feeding.

The quality of final products depends on just from the effectiveness of the castration procedure execution (Moore, 2017), in particular the composition of carcasses, which form the price of meat (Weiler et al., 1995).

The European scientific community for a long period of time developed a variety of approaches to reduce the possible negative impact on the industry from the prohibition of surgical castration without anesthesia (Willeke et al., 1987). In such projects Ukrainian scientific institutions were also participated. In fact, substances that cause a specific odor are known (Zamaratskaia et al., 2005). However, the development of ways to reduce them in carcasses of pigs remains in the field of scientists by this time.

Currently, among a lot of possible variants of fattening pigs without the use of surgical castration can be considered various approaches, which can be classified into separate groups: improvement of technological processes of breeding and fattening pigs – use of fodder for reduction of specific odor (Frieden et al., 2011), selection of animals with no/low odor (Frieden et al., 2014), use of sexually transmitted sperm (Hofmo, 2006); improvement of the technology of pig products processing – slaughter of animals in young sexually immature age (Hart et al., 2016), creation of an additional control point in the meat processing plant to assess the received carcasses for the presence of odor, development of special equipment – "electronic nose"; preparation of special recipes for meat products from pork and implementation of additional technological techniques to mask the possible odor (Meinert & Dall Aaslyng, 2017), a special marking of non-castrated boar's carcasses. However, the most controversial issue is the introduction of immunological castration (Frieden et al., 2011).

For conducting the research at the complex of LLC "NPP" Globinsky pig complex in Obiznivka village, Globynsky rayon (Ukraine) by the method of pair-analogues at the time of birth of the pigs, two groups of experimental hogs were formed with an average weight of 1.27 kg in number of 75 heads each. Animals of the first group were castrated surgically on the fourth day of life. Animals of the second group were vaccinated twice with immunization vaccine of Zoetis in accordance with the instructions for use.

As a result of these actions the drug, all the problems that can occur with traditional surgical castration, include the smell-disappear. Economic benefits from the use of "Improvak" and its specifications are confirmed by numerous practical research conducted by both domestic and foreign experts. Thus, some studies provide information that carcasses of immunological castrated boars have a higher lean meat yield of 3.4% compared to the castrated surgically method

Table 1. Increasing the average daily gain and improvement the quality of animals carcasses injected with Improvak compared with surgical castrated

Research number	Number of animals	Average weight at slaughter, kg	Improvement of indicators, %			Reducing the number of spinal bacon, %
			FCE (feed conversion efficiency)	ADG (average daily gain)	Lean meat output	
1	24	108-110	7.7	ND	7.7	22.4
2	30	100-105	15.1	6.8	ND	7.2
3	50	96-100	10.0	SID	ND	17.4
4	50	113-120	16.9	SID	ND	11.7
5	260	100-110	ND	SID	1.4	ND
6	60	105-110	7.9	4.8	ND	12.1
7	24	125-138	9.3	10.6	9.3	ND
8	160	125-130	9.6	2.3	7.6	8.1
9	24	115-120	7.3	SID	ND	13.5
10	120	125-135	5.7	4.0	ND	ND

ND – no statistically data; SID – statistically insignificant deviation (less than 0,01%)

(Giri et al., 2002). However, a number of researchers believe that the method of castration does not significantly affect the yield of lean meat from the carcass (Daxenberger et al., 2001; Prunier et al., 2006), as well as the level of pH (Zamaratskaia et al., 2008) loss of moisture and change the color of meat (Škrlep et al., 2012, 2016).

The following results were obtained:

• The average gain per day in fattening animals grew by 5.2%, which was 635 g/day in the control group compared with 603 g/day for the same period of time in the group of castrated animals grown under traditional technology.

• The feed conversion rate of the group in which Improvak was used was improved by 8% – the value of 3.56 in the control group versus 3.87 in the group of normal animals.

• The thickness of the sphincter in the area of the sixth to seventh thoracic vertebra decreased by 20% – the rate for the control group of tested pigs was 23.05 mm versus 28.82 mm in the pigs who did not receive the drug.

• The amount of lean meat from the Improvac group pigs increased by 3.4% (experiments were carried out two times) from 54.3% to 57.7% in the total amount of meat received from carcasses.

The results show that the vaccine «Improvak» increases the efficiency and profitability of pork. To determine the slaughter and meat characteristics of sebaceous ink boars castrated by surgical and immunological method, two groups of 30 animal heads in each were formed. Before slaughter, the animals are grouped by weight and the average live weight for each group was measured. After slaughter, the following parameters were measured: carcass weight pair; slaughter exit; length of carcass and bacon halves; thickness of bacon on the shoulder, at 6/7 thoracic vertebra and the sacrum.

After cooling and maturation, the carcass overgrowing and coating was carried out and the following parameters were measured: mass loss after cooling; ham weight and its share in the total mass of carcasses; the total mass and the proportion of bones, fat and meat in the carcass.

Our studies show that a higher slaughter yield characterized animal neutered by immunological castration – 73.42%, at the same time they had seen more losses after cooling (1.46%).

Results and Discussion

All animals were kept in groups and received the same balanced diet. But the results of animal productivity began to vary from 28 to 176 days of fattening (after the injection of the second dose of the drug).

Table 2. Comparative characteristics of the productivity of fattening animals from 28 to 176 day feeding

Indicator	Surgical castrates	Immunological castrates	P-indicator
Feed consumption, kg/day	1.89	1.74	0.0008
Feed conversion, kg	2.47	2.28	0.0001
Carcass weight, kg	101.50	108.25	0.99
Back fat, mm	20.07	15.52	0.011
Lean meat output, kg (%)	61.83 (47.87)	66.11 (52.49)	0.0015 (0.012)

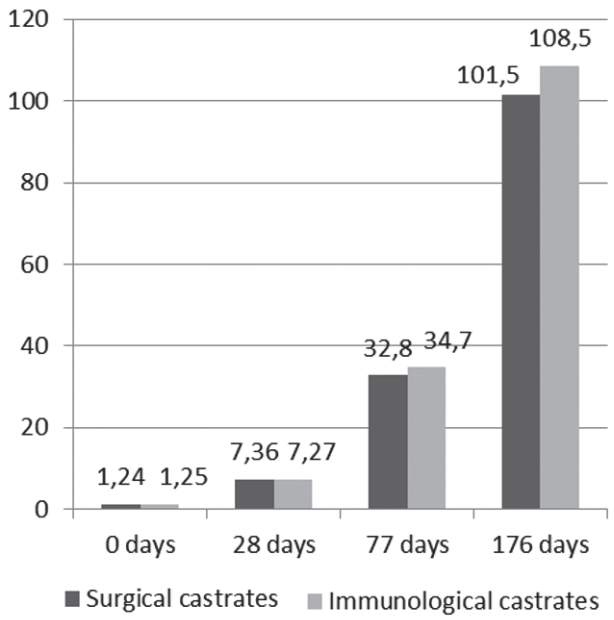

Fig. 1. Dynamics of the change in weight of the boars in different methods of castration

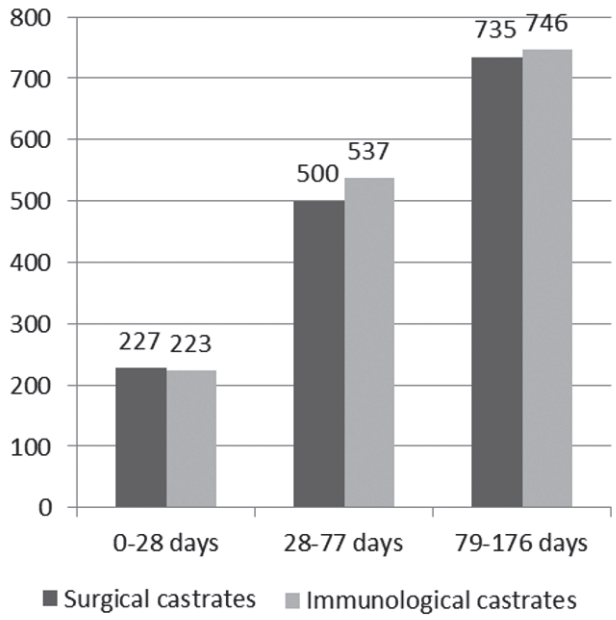

Fig. 2. Average daily gain for animals in different methods of castration

The following morphometric parameters were determined: length of carcass, thickness of bacon on the shoulder, at 6/7 thoracic vertebra and the sacrum, with the subsequent carcass cutting in accordance with the procedure adopted in the meat processing plant (cervical spatula, spinal-edema and hip parts). In order to release the outputs of various tissues the carcass dissection was carried out in accordance with existing methods, during which the production of high-volume semi-finished products was also evaluated.

During the dissection of pig carcasses immunologically castrated more meat and less fat were received (Table 3). The advantage of the content of muscle tissue was 4.62%, the fat content was 5.93%, compared with the carcasses surgically castrated pigs.

The evaluation of the output from the carcasses of large-scale semi-finished products showed an advantage of carcasses of immunologically castrated pigs (Table 4). For instance, sirloin was harder to 0.16%, neck – 0.38%, boneless loin – at 0.68%, meat, ham – at 1.98%. In general, the superiority of the group of immunologically castrated pigs over surgically castrated in the content of the most valuable large-scale semi-finished products was 3.20%.

The results of the conducted research give grounds to assert that the use of the method of immunological castration of boars during their fattening can provide an increase in the quality parameters of their carcasses. At the same time, it should be noted that in order to formulate final conclusions, it is necessary to add the necessary economic research in the slaughter of surgical and immunological castrated pigs.

Table 3. Total weight and proportion of meat, fat and bones in carcass

Castration method	Total weight, kg			Share in carcass, %		
	meat	bones	fat	meat	bones	fat
Surgically	40.22±2.66	9.44±0.35	25.41±1.04	53.47±2.12	12.57±0.23	33.96±2.23
Immunological	42.76±1.76	10.22±0.46	20.64±1.55	58.09±1.79	13.88±0.49	28.03±2.07

Table 4. The mass of the most valuable bulky half-carcasses

Castration method	Total weight, kg				Share in carcass, %			
	sirloin	neck	boneless loin	ham	sirloin	neck	boneless loin	ham
Surgically	1.3 (±0.0)	4.2 (±0.3)	4.8 (±0.5)	14.0 (±0.9)	1.5 (±0.1)	5.6 (±0.3)	6.4 (±0.5)	18.6 (±0.7)
Immunological	1.2 (±0.1)	4.4 (±0.3)	5.5 (±0.1)	15.1 (±0.4)	1.7 (±0.1)	6.0 (±0.5)	7.1 (±0.1)	20.6 (±0.6)

Initial data for calculation of efficiency of methods of castration

Indicator	Signification	
	Surgical castration	Immunological castration
Animal live weight at slaughter, kg	3282	3353
Live weight price, UAH/kg (free of VAT)	38.75	38.75
Total costs, UAH	127177.5	129928.8
Output after dissection, kg (%)	2470.5 (75.3%)	2477.6 (73.9%)
Output of commodity products, kg (%)	2107.5 (64.2%)	2096.57 (62.5%)

Thus, the comparative economic characteristics of the two groups of animals confirmed the above conclusions regarding the high quality of carcasses of male pigs castrated by immunological method. Thus, immunological castrate consumed 20 kg of feed less (8%) and gave 4.62% lean meat more.

For a more detailed study, the cost of the vaccine should be taken into account by calculating the cost of growing pigs (Table 6). The cost of surgical castration in the calculation of cost is not included, because the operation has been done by staff zootechnician.

The performed calculations finally confirmed the benefits of using the immunological castration in comparison with traditional surgical method:

During the fattening period, immunological castrates had 10 g higher daily average gain, and at the end of the fattening period, they achieved a live weight of 3.9 kg higher than the castrated surgical boars.

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After the dissection from immunological castrated were obtained more meat and less fat. Revenue from sales of commercial products from immunocastrates is higher by 2.3%.

Table 5. Comparative characteristic of economic efficiency of pig castration by surgical and immunological methods

Indicators	Surgical castration			Immunological castration		
	kg	UAH/kg (free of VAT)	∑, UAH	kg	UAH/kg (free of VAT)	∑, UAH
Output after dissection						
Bones	327.0	0.008	3	343	0.008	2.744
Limbs	25	39.60	993	26.99	39.6	833.991
Tail	11	18.85	207	11	18.85	207.35
Total output	363	–	1203	380.99	–	1044.085
Output of commodity products						
Shoulder	175.86	74.56	13112.53	178.87	76.32	13652.78
Neck	133.17	62.91	8377.98	137.75	64.40	8871.35
Pork shovel cooled	259.78	57.31	14890.54	272.23	58.67	15973.67
Rump steak	34.21	74.56	2550.778	36.21	76.32	2763.85
Ham	529.1	61.97	32793.59	521.33	63.44	33077.14
Pork breast	371.28	65.24	24223.07	359.84	66.78	24032.62
Lateral bacon	285.17	25.63	7309.13	264.56	26.23	6941.44
Vertebrae bacon	112.7	30.29	3413.79	107.16	31.00	3322.84
Shank	54.06	27.96	1511.56	53.97	28.62	1544.78
One species pork	152.17	58.71	8935.09	164.65	60.11	9896.83
Total output	**2107.5**	**–**	**117118.1**	**2096.57**	**–**	**120077.3**
Total output of commodity products	**2470.5**	**–**	**118321.1**	**2477.6**	**–**	**121051.4**
Costs per 1 kg of commodity products (by weighted average), excluding VAT			51.48			52.44
Internal price per 1 kg of commodity products (by weighted average), excluding VAT			47.90			48.86
Payback costs, %			93.0			95.2

Table 6. The cost of pork production by the various types of animal castration

Total costs		Surgical castrates	Immunological castrates	Surgical / Immunological castrates	
				D	%
Feed costs	Costs per 1 animal, UAH	2 441.14	2 288.90	-152.24	93.76
	Weight of 1 animal, kg	101.50	108.25	6.75	106.65
	Costs per 1 kg, UAH	24.05	21.14	-2.91	87.92
Veterinarian costs					
Vaccine	Costs per 1 injection, UAH	41.45			
	Amount of injection for 1 animal, times		2.00	2.00	
	Costs for vaccination per 1 animal, UAH		82.89	82.89	
Feed costs + Vaccine					
Feed costs + Vaccine	Costs per 1 animal, UAH	2 441.14	2 371.80	-69.34	97.16
	Weight of 1 animal, kg	101.50	108.25	6.75	106.65
	Costs per 1 kg, UAH	24.05	21.91	-2.14	91.10
Total costs per 1 kg of live weight, UAH		30.06	27.39	2.68	91.10

Conclusion

The problem of painless pig production is becoming more and more relevant throughout the world, as consumers want to eat "happy" pork and protest against the cruelty toward animals. Usually to avoid the appearance of smell meat boars are castrated at young age without anesthetic. In December 2011 the European Commission adopted the Declaration "European Declaration on alternatives to surgical castration of pigs", according to which the EU pig producers have to completely abandon the traditional procedure until 2018. The obtained data testify that immunological castration ensures increase of production efficiency and humanity to animals.

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Received: 22.03.2018; *Accepted*: 11.04.2018