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Economic Aspect of Growing Pigs with Respect to Sex and Immunocastration

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Abstract

The minimization of boar taint according to welfare appears to be immunocastration. For this purpose a test was carried out for a total of 80 piglets in the growing stage. Animals were housed by sex, respectively 20 boars, 20 immunocasatrates, 20 barrows and 20 gilts. Animals were fed ad libitum, and the production variables were observed with an emphasis on the overall economy of their production. Intergroup differences were tested by variance analyse and the test groups of growing pigs were evaluated using a profit formula.

It was shown that animals in the growing period had excellent parameters of the fattening (in the 65 days, the total gain was 19 kg, with daily feed intake below 0.7 kg, feed conversion ratio 1.2 kg and average daily gain 540-560 g). The effect of sex, or the castration of young pigs on the economy of the pig production in growing period is proved to be insignificant. This hypothesis was confirmed.

Keywords

Pig, grower period, fattening capacity test, sex, immunocastration, profit formula, economy.

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Introduction

Nowadays the emphasis is put on the food production. Problems of dioxins, GMOs, general protein deficit, antibiotics, use of animal proteins in animal feed, mycotoxins, BSE, etc. have been and are being solved. For pig production, this means, on the one hand, constant improvements their performance by classical zootechnical organizational tools, ie hybridization and selection (Tholen et al., 1996; Edwards, 2005; Ngapo, Gariepy, 2008; Babovic, 2011). On the other hand, an implementing a new technologies to make more efficient and improve living conditions. Technology innovations take place in all categories of pigs, some of them raise a debate on ethics and welfare. At present, within welfare of livestock, it is using the influence of different sexes on their production performance. In this case, it is a solution to the problem of eliminating castration of the boar piglets (Dekkers and Hospital, 2002; Krieter, 2002; Prunier et al., 2006; Fredriksen et al., 2011; Maiorano et al., 2012; Velechovská, 2012; etc.). Measure eliminates the occurrence of "boar taint" in pork meat and fat. This is unacceptable for consumers (Engelsma et al., 2007). Admissible levels of both are for androstenone > 1ppm, skatole > 0.25 ppm (Xue et al., 1996; Whittington et al., 2011). The problem is still realized by surgical castration without anesthesia (Edwards 2008; Fredriksen et al., 2008; Boneau et al., 2009; Batorek et al., 2012). The above mentioned thema solve and realize in the EU the European Food Authority, the trade chains and the relevant legislation (Bernardy, 2010). This measure is tolerated by the end of 2018.

The recommended option of eliminating boar taint at minimal economic loss is immunostaining. It is a vaccine stimulating the production of specific gonadotropin-releasing hormone (GnRH) antibodies suppressing testicular function (Zamaratskaia et al., 2004). Its application is recommended at 8 weeks of age with subsequent revaccination after 4 weeks. The thesis deals with the extent to which the sex and immunocastration of pigs influences their production performance in the growing period, respectively their impact on the production economy.

The objective of the test in the growing period fattening (GP), (7-30 kg), was to verify

the influence of sex, respectively the method of castration (boars-♂, immunocastrates-ik, barrows-⚲, gilts-♀) on its parameters of fattening capacity with emphasis to the overall economy of their production.

Materials and methods

1. Hypothesis

The first vaccine of boar has no significant effect on the production level performance and effectiveness compared to other sex categories in pigs.

2. Animals

The research test was conducted in March-April 2017. A total of 80 pigs crossbred population D x (LWxL) were housed in the Experimental Test Station of the Czech University of Life Sciences Prague and divided according to sex. There were 20 boars (♂), 20 immunocastrates (ik), 20 barrows (⚲) and 20 gilts (♀). All animals were labeled by electronic ear chips. The growing period of animals lasted 36 days (from weaning to 66 days of age) of their age with a live weight of 9-30 kg.

3. Housing, microclimate

In the growing period, the animals were housed in groups of 20 by sex (♂, ik, ⚲, ♀). Microclimate in the test station, respectively temperature, gas concentration, relative humidity, were controlled automatically and monitored every hour to meet the requirements of the animals of the given age (MÖLLER, s.r.o., AGE s.r.o.).

4. Castration

In order to obtain the immunocastrates, the 2nd group of boars was chemical castrated the 5th day after penned. This group of animals received Improvac®, which contained 200 µg of GnRH protein conjugate/ml in an aqueous adjuvant solution.

5. Nutrition, feeding

They were fed ad libitum with complete feed mixtures (CFM) the composition of which were continually adjusted with respect to the age and weight of the pigs. In the growing period, the CFM-starter (creap and weaning by De Hoist, The Netherlands), ČOS and A_1 were used (Table 1, Table 2).

6. Variables

The purpose was to obtain a longitudinal size-age type dataset, where all the animals have all the data from the same age in the test. Due to the technological equipment of the test station, the data characterizing the growing stage in pigs were obtained as an average.

For data describing the growth of the monitored animals, at each stage of each animal we regularly weighed at the same time at weekly intervals, at the same time, to obtain a live weight in kg (LW). In addition, the animal´s daily feed intake in kg (DFI), feed conversion in kg (FCR) and average daily gain in g (ADG) were monitored as well.

CFM	Feeding time (day)	Price of 1 kg CFM (CZK/EUR)
Creap	31-38	17.85/0.66
Weaning	38-45	14.95/0.55
ČOS	45-59	9.85/0.37
A1	59-66	7.09/0.26

Note: CFM prices and food components relate to January-March 2017
Source: Pig Breeding Test Station CULS Prague

Table 1: Feeding scheme for pigs in the growing period.

ČOS	%	CZK/kg (EUR/kg)	CZK/EUR	A1	%	CZK/kg(EUR/kg)	CZK/EUR
wheat	40	5.5 (0.20)	2.2/0.08	wheat	44	5.5 (0.20)	2.42/0.09
barely	29	5 (0.19)	1.45/0.05	barely	35.3	5 (0.19)	1.76/0.07
soya	20	11.5 (0.43)	2.3/0.09	soya	17.7	36 (1.33)	2.04/0.08
sugi	10	36 (1.33)	3.6/0.13	sugi	.	36 (1.33)	.
oil	1	30 (1.11)	0.3/0.01	oil	.	30 (1.11)	.
aminogold	.	29 (1.07)	.	aminogold	3	29 (1.07)	0.87/0.03
Total	9.85 (0.37)			Total	7.09 (0.26)		

Note: CFM prices and food components relate to January-March 2017
Source: Pig Breeding Test Station CULS Prague

Table 2: Composition and price of used CFM.

7. Processing results

All partial data were processed by common mathematical and statistical methods (SAS Inst. Inc., Cary, NC), expressed with respect to sex in tables. Differences between groups were tested by variance analysis (Tuky test).

When determining the yields of subpopulations in pigs, it is necessary to assess their performance fundamentally complex (Sellier, 1976). It is the expression of the profitability of the test groups using the profit formula, which is determined by the profit equation used in the production economy and the econometrics in finding the variable cost corresponding to the maximum profit that can be achieved.

The test was therefore evaluated economically with regard to test groups of pigs using a profitable function (Poděbradský, 1980; Župka, 1992) of the following shape:

$$Zc = \{c_1 y_1 - [n_1 x_1 + n_2 x_2 + (n_3 : x_3) + A]\} \times r,$$

where

$$r = 365 : (x_2 + k);\ x_2 = (\acute{y}_1 - \acute{y}_0) : \acute{}x_2;\ Zc = Z \times r,$$

where:

Zc - profit per capita unit per year,

Z - profit per slaughter pig,

r - the rate of pig turnover per year,

c_1 - the average realization price per unit of half-carcasses production,

n_1 - cost (price) per CFM unit,

n_2 - fixed costs for 1feeding day of fattening pig,

n_3 - costs per 1 sow and litter without the costs of nursing and feeding of piglets,

A - costs of nursing and feeding of piglets,

y_1 - carcasses weight,

$\acute{y}_1$ - live weight of slaughter pig,

$\acute{y}_0$ - live weight of grower when start of fattening,

x_1 - amount of CFM consumed,

x_2 - fattening time,

$\acute{}x_2$ - average daily weight gain from start of growing to removal,

x_3 - number of reared piglets per sow and litter,

k - days between 2 turns.

In our case, this is reduced only to indicators that measure the running test costs, ie the cost of purchasing weaners and feed costs.

Results and discussion

Evaluation of the fattening capacity of tested pigs by sex in the growing period is showed in Tables 3-4.

At the beginning of the growing period (at 31 days), the highest average starting weight had boars (9.4 kg) and barrows (9.1 kg). Followed by immunocastrates (9 kg) and the lightest live weight were in gilts (8.9 kg). Because the differences in weights were insignificant, other phenotypic values of production performance can be compared to each other.

In the following weeks, the order of precedence was alternated, so at the end of the test, the order f convenience was boars (29.1 kg), immunocastrates (28.4 kg), gilts (28.3 kg) and barrows (28 kg). Concerned of the total gain per grower period (Σ), the order of convenience was 19.7 kg for boars, for gilts and immunocastrates 19.4 kg and barrows 19 kg.

In the daily feed intake (DFI) at the beginning (31 days of age) was the order barrows and boars (0.3 kg/day), then gilts with immunocastrates

Variable	LW (kg)								DFI (kg/day)			
Age (days)	♂		♀		♂		ik		♂	♀	♂	ik
	x	s	x	s	x	S	x	s	x	x	x	x
31	9.1	1.4	8.9	0.4	9.4	1.8	9.0	0.4	0.3	0.2	0.3	0.2
38	11.0	1.8	9.9	3.0	10.8	1.5	11.2	3.0	0.4	0.3	0.3	0.3
45	12.8	2.4	13.8	1.0	13.7	2.6	16.2	1.0	0.6	0.6	0.6	0.6
52	18.1	4.7	18.1	1.7	18.8	2.7	18.4	3.5	0.9	0.8	0.8	0.6
59	21.8	6.4	23.5	2.8	23.3	3.3	23.5	2.8	0.9	1.1	1.0	1.1
66	28.0	7.5	28.3	3.0	29.1	3.3	28.3	3.0	1.3	1.2	1.3	1.3
Σ	19.0	7.1	19.4	2.9	19.7	2.5	19.4	2.9	0.69	0.69	0.68	0.66

Note: Significance: all intergroup differences were statistically insignificant
Source: Pig Breeding Test Station CULS Prague

Table 3: Fattening capacity evaluation with respect to sex of the growing period in pigs (n = 79).

Variable	FCR (kg CFM/kg gain)				ADG (g)							
Age (days)	♂	♀	♂	ik	♂		♀		♂		ik	
	x	x	x	x	x	s	x	s	x	s	x	s
38	1.4	2.34	1.6	1.0	273	94	139	449	207	160	317	148
45	2.2	1.01	1.4	0.8	266	240	555	461	417	271	705	187
52	1.2	1.36	1.1	1.9	744	543	613	143	721	165	319	228
59	1.7	1.44	1.5	1.7	540	296	773	184	653	147	640	196
66	1.4	1.81	1.5	1.7	884	232	688	127	817	142	784	119
Σ	1.28	1.25	1.21	1.20	541	202	554	83	563	70	553	136

Source: Pig Breeding Test Station CULS Prague

Table 4: Fattening capacity evaluation with respect to sex of the growing period in pigs (n = 79).

(0.2 kg). Over the next weeks the DFI of all groups were practically the same. At the end of the growing period, the lowest daily feed intake was in gilts (1.2 kg), the other categories showed this variable 1.3 kg. The order of total daily feed intake is barrows and gilts (0.69 kg), boars (0.68 kg) and immunocastrates (0.66 kg).

As the feed conversion ratio (FCR) is concerned, at the beginning growing period (38 days), the order of convenience was immunocastrates (1 kg), barrows (1.4 kg), boars (1.6 kg), gilts (2.34 kg), however in the next following weeks the order was changed. In terms of economic advantage, the overall average feed conversion ratio for barrows was the worst (1.28 kg), following gilts (1.25 kg), immunocastrates (1.21 kg) and boars (1.20 kg).

When it comes to the growth intensity of the test groups of animals in the test, at the beginning test the highest ADG shows immunocastrates (317 g), barrows (273 g), boars (207 g) and gilts (139 g). At the end of the growing period the order of advantage was barrows (884 g), boars 817 g), immunocastrates (784 g) and gilts (688 g). Regarding the overall order of average growth intensity, the order of the groups were boars (563 g), gilts (554 g), immunocastrates (553 g) and barrows (541 g). However the differences between groups were statistically insignificant.

The following Table 5 evaluates the indicators influencing the economy of pigs in the growing period.

It is clear from the table that the initial body weight of all groups were balanced, they moved in a range of 0.5 kg. This fact is most important for tests, because the body weight/age, significantly affecting other performance indicators. Gilts at 31 days reached the lowest average weight, 8.9 kg. The heaviest were the boars (9.4 kg) who also reached the highest absolute body gain (19.7 kg) at the end of the growing period. The same values (19.4 kg) achieved immunocastraces and gilts, barrows then 19 kg. The initial body weight then affected the price of piglets, ranging from 1 162/43.01 (gilts) to 1 216/45.00 CZK/EUR (boars).

As it was mentioned above, the economic evaluation of the test included only the costs of buying weaner and feed. The facts are documented in Tables 6 and 7.

It is clear that the DFI of the experimental animals in the test without respect to sex was virtually the same (28-29 kg), which was reflected at practically the same feed cost (242-264 /8.96 – 9.77 CZK/EUR) and the average price of 1 kg CFM (8.70 - 9,08/0.32 – 0.34 CZK/EUR).

The lowest cost per 1 piglet, due to low weight, are in gilts (1 162/43.01 CZK/EUR), the highest, due to the highest weight, is for boar (1 216/45.00 CZK/EUR). The purchase price of the immunocastrate was 1 170/43.30 CZK/EUR and the barrow CZK /EUR 1 179/43.63. Adding the cost of a feed then costs per 1 piglet ranging from 1 418/52.48 CZK/EUR (gilts) to 1 472/54.48 CZK/EUR (boars).

By dividing them by the weight of a given group at the end of the test, the cost per 1kg of the test can be determined. However, the differences between groups are small, at an absolute value of 1.85/0.07 CZK/EUR. It can be said that the most expensive kilogram of the animal was for the barrow (51.57/1.91 CZK/EUR), the cheapest for the immunocastrate (49.72/1.84 CZK/EUR). Price of 1 kg of boar, resp. gilt, then 50.58/1.87, respectively 50.11/1.86 CZK/EUR.

As far as the test results are concerned, Hovorka et al. (1983) has already pointed out that the sex or castration, and hence the economy of production, significantly affects production characters in pigs. But this influence starts be

Variable / sex	♂	♀	♂	Ik
Average live weight (LW) at 31 days (kg)	9.1	8.9	9.4	9.0
Piglet price (130 CZK/kg) / (4.81 EUR/kg)	1 179 / 43.63	1 162 / 43.01	1 216 / 45.00	1 170 / 43.03
Average live weight (LW) at 66 days (kg)	28.0	28.3	29.1	28.4
Total body gain (kg)	19.0	19.4	19.7	19.4

CFM prices and food components relate to January-March 2017
Source: Pig Breeding Test Station CULS Prague

Table 5: Cost per 1 weaner in the growing period with respect to sex.

Component	Price / kg CZK / EUR	♂		♀		♂		ik	
		kg	CZK/EUR	kg	CZK/EUR	kg	CZK/EUR	kg	CZK/EUR
Creep	17.85 / 0.66	0.8	14/0.52	0.6	10/0.37	0.8	14/0.52	0.5	9/0.33
Weaning	15.0 / 0.56	2.7	40/1.48	2.3	34/1.26	2.3	34/1.26	2.1	32/1.18
ČOS	9.9 / 0.37	10.2	101/3.74	9.8	96/3.55	9.9	97/3.59	8.2	81/3.00
A1	7.1 / 0.26	15.4	109/4.03	16.5	117/4.33	15.7	112/4.15	16.9	120/4.44
Total (kg)	.	29	264/9.77	29	257/9.51	29	257/9.51	28	242/8.96
Price (CZK/kg)(EUR/kg)	.	9.08 (0.34)		8.84 (0.33)		8.95 (0.33)		8.70 (0.32)	

CFM prices and food components relate to January-March 2017
Source: Pig Breeding Test Station CULS Prague

Table 6: Consumption and price of TFMs in test with respect to sex.

Variable / sex	♂	♀	♂	ik
Cost per:				
- 1 weaner CZK (EUR)	1 179 (43.63)	1 162 (43.01)	1 216 (45.00)	1 170 (43.30)
- feeding one weaner in test CZK (EUR)	264 (9.77)	257 (9.51)	257 (9.51)	242 (8.96)
Cost per 1 weaner (CZK (EUR) / head)	1 444 (42.34)	1 418 (52.48)	1 472 (54.48)	1 412 (52.26)
Cost per 1 weaner (CZK(EUR) / kg)	51.57 (1.91)	50.11 (1.86)	50.58 (1.87)	49.72 (1.84)

CFM prices and food components relate to January-March 2017
Source: Pig Breeding Test Station CULS Prague

Table 7: Economic evaluation of test groups of pigs on the basis of purchase price of pigs and CFMs by sex.

significant approximately from the body weight of 50 - 70 kg in pigs (Stupka et al., 1998; Vanheukelom et al., 2012; Robina et al., 2013; Serano et al., 2013). With respect of the genetic shift in the pig population, as well as the economics, Morales et al. (2011), Grela et al. (2013), Čítek et al. (2014), Šprysl and Stupka (2003) also confirm this.

Conclusion

The animals in the test during the growing period showed excellent fattening parameters, with a total increase of 19 kg in 65 days, a DFI of 0.7 kg, a FCR 1.2 kg and an ADG of 540-560 g.

The high performance of current modern pig genotypes, especially in the growing periode later influencing the overall production economy, was pointed out by Stupka et al. (1998). They mentioned that due to "maker assisted selection (MAS)" can be expected a significant changes in reproductive and production performance in pigs. This phenomenon also needs to be adapted to new technologies. The authors also demonstrated that the influence of sex and castration in young pigs is insignificant as mentioned already Hovorka et al., (1983). Genetic progress in production performance in the pig population, and the impact of sex on the economy also showed above mentioned authors (Šprysl and Stupka, 2003; Morales et al. 2011; Grela et al. 2013; Čítek et al. 2014).

In assessing the overall economy showed that the ascending order of preference, in terms of economic benefit, in this test achieved

immunocastrates, gilts, barrows and boars. It was confirmed, that the influence of sex or castration in young pigs is insignificant. This fact confirmed the given hypothesis.

It can be said that "classical" pathways, minimizing boar taint in pork meat (castration, immunocastration), with regard to the pig production economy and "no harm to the animals", will be pursued in the future in other ways by breeding (Wood et al.) and successive changes in consumer habits (Lamb, 1994).

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