

## Effect of housing system on fattening and slaughter results and profitability of pig fattening

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**Abstract:** *Effect of housing system on fattening and slaughter results and profitability of pig fattening.* The study was performed on a fattener farm in a pig house with and without bedding material. In each housing system, Landrace × Duroc weaners imported from Denmark, with an initial weight of 25–30 kg, were fattened in three different seasons. Animals were fed *ad libitum* with mixed feeds prepared on the farm. The study determined mortality, daily gains, feed conversion (kg feed/kg gain), daily feed intake, hot carcass weight, and meatiness. A simplified economic calculation of fattening costs was made. Pigs kept on litter were characterized by lower daily gains (10–20%), lower daily feed intake (5–10%), less efficient feed conversion (5%), and higher lower meatiness (1–2.9% point). Taking into account the costs incurred during the fattening process and revenue from the sale of fattening pigs and natural fertilizer, keeping the pigs without bedding proved more profitable. Difference totaled 0.16 PLN per 1 kg hot carcass weight.

*Key words:* pigs, fattening, housing system, profitability

### INTRODUCTION

Poland is a significant producer of pigs in Europe. According to the Central Statistical Office (GUS 2019), the pig population in Poland in December 2018 was 11,027.7 thousand head, a decrease

of 7.4% in relation to the same period of 2017. The most common reason given for reducing the population was that live pig production is unprofitable, mainly due to an unfavourable relationship between prices of fattening pigs and prices of cereals (Pepliński 2013). Out of the 11,027.7 thousand pigs, 43.2% were fatteners. This production group is kept in two systems: with bedding material, which is more popular in less intensive production systems (Rekiel et al. 2018), and without bedding material, which is predominant in intensive pig farms (van de Weerd and Day 2009).

In the litter housing system, pigs spend less time resting, are longer active and less aggressive than in the litterless system. Litter housing also reduces the proportion of undesirable behaviours such as tail biting, ear biting, and mount attempts (Day et al. 2008, Jordan et al. 2008). Animal welfare levels increase as do the costs of production, because bedding material involves costs and higher labour inputs associated with provision of bedding material and removal of manure. When the number of animals on a farm is large, it is more problematic to obtain straw for bedding (Winnicki and Jugowar 2011). At present, bedding

may increase the risk of spreading the ASF (African swine fever) virus. Epizootic data gathered by the Veterinary Inspection shows that in Poland, the most common vectors for ASF transmission were forage, hay and straw (Pejsak and Woźniakowski 2017). These risks and costs increase the interest in housing pigs without bedding material. As reported by Fugol and Szlachta (2010), litterless housing is economically more favourable due to lower labour inputs, no bedding purchase costs, and profit from the sale of slurry as a substrate for biogas production. Litterless housing facilitates good hygiene in the pig house (Winnicki and Jugowar 2011). Lower labour inputs and lower maintenance costs provide an incentive to keep fatteners in the system without bedding material, but some pork-buying consumers are interested in housing conditions of the animals from which this meat was sourced. The question is whether obtaining 1 kg of pork from a pig kept on litter costs the same as from a pig kept without bedding.

The aim of the study was to determine the effect of housing system on performance of fattening pigs and profitability of fattening.

## MATERIAL AND METHODS

The study was conducted on a fattening pig farm in two systems: on shallow litter and without litter (full grating). Landrace × Duroc weaners imported from Denmark, with an initial weight of 25–30 kg, were investigated. The animals were of a high health status. In each housing system, pigs were fattened in three different seasons: winter, spring–summer, and summer–autumn.

In the litterless system, there were twelve pens each with 750 pigs: six pens each with 62 pigs and six pens each with 63 pigs. Each pen had an area of 65 m<sup>2</sup>.

In the litter system, there were three pens each with 300 pigs: two pens with an area of 92 m<sup>2</sup> (90 animals per pen) and one pen with an area of 125 m<sup>2</sup> for 120 pigs. Manure was spread and removed twice a week. Barley and wheat straw were used as bedding material.

The farm complied with the animal welfare requirements specified in the Regulation of the Minister of Agriculture and Rural Development of 15 February 2010 (Rozporządzenie..., 2010) and with the biosecurity requirements (Rozporządzenie..., 2018).

Two-stage fattening was based on complete diets prepared on the farm (Table 1). Pigs were fattened to around 40 kg of body weight in the first stage and from 40 kg until sold in the second stage. Animals had access to feed and water *ad libitum*. After reaching slaughter weight, the fatteners were slaughtered in meat manufacturing plants in compliance with the applicable procedures. Hot carcass weight and dressing percentage were determined. Meatiness of carcasses was evaluated using ultrasound equipment Ultra-Fom 300, and the carcasses were graded according to the EUROP classification system.

The study determined fattening duration, total weight gain, daily weight gain, feed conversion (kg feed/kg gain), dressing percentage, and meatiness. A simplified economic calculation of fattening costs was made. Manure and slurry prices were based on the prices in force on 15 March 2019; the other prices are actual prices in a given production period.

TABLE 1. Ingredients of the feed mixtures, their energy, feeding value and price

Item	Fattening period	
	I	II
Ground triticale	44.0	64.8
Ground barley	35.0	20.0
Soybean oil meal	15.0	11.0
Supplementary mixture*	4.0	2.0
Finely ground limestone	0.5	1.2
Soya oil	1.5	1.0
Energy and nutritional value of the mixture		
Energy of the mixture (kcal)	2 342	2 395
Protein (%)	17.4	15.5
Lysine (%)	1.2	1.0
Methionine + Cysteine (%)	0.7	0.6
Price (PLN/dt)	113	96

\*I – proportion in 1 kg: Ca 4.8%, Na 17.0%, P 4.0%, Lys 11.0%, Met 3.5%, Thr 5.0%, Trp 1.0%; vitamins: A 35 000 IU, E 100 mg, B<sub>2</sub> 120 mg, B<sub>12</sub> 750 mg; Fe 3 400 mg, Cu 4 000 mg, Zn 3 500 mg, I 40 mg, Se 10 mg.

\*II – proportion in 1 kg: crude protein 32.5%, Ca 6.1%, Na 11.5%, P 0.1%, Lys 18.1%, Met 4.1%, Thr 7.0%; vitamins: A 325 000 IU, E 6 000 mg, D<sub>3</sub> 65 000 IU; Fe 3250 mg, Cu 650 mg, 3900 mg, I 65 mg, Se 10.4 mg.

## RESULTS AND DISCUSSION

During whole period of observation no mortality was observed for pigs fattened in winter on litter (Table 2). In the other fattening seasons, weaners mortality was low. Mortality exceeded 1% for pigs fattened during summer–autumn in both the litter-based (1.7%) and litterless systems (1.2%). Mortality in the litter-based system was 0.66% for all three fattening seasons and similar to the observations of Kralik et al. (2013), it was slightly lower than in the litterless system.

The mean body weight of the animals at the beginning of fattening was similar in both housing systems (Table 3). The highest daily gain was achieved in the litterless system during winter (1229 g).

Compared to the spring/summer and summer/autumn fattening, weight gains during the winter period were higher by 79 g and 118 g, respectively. In the litter-based system, regardless of the fattening season, daily gains of the pigs were lower than in the litterless system by 10–20% and were approximately 1000 g. Karpiesiuk et al. (2016) observed a similar trend: pigs kept on shallow litter (in summer period) showed lower daily gains than those raised without litter. The difference in daily gains was 4%. The lower daily gains of the pigs fattened in pig houses on litter compared to those raised in the litterless system could be due to lower daily intake of concentrates (Morrison et al. 2003) and higher physical activity of the fatteners (Day et al. 2008, Jordan et

TABLE 2. Characteristics of the fattening period

Item	Housing system					
	Litter			Litterless		
	I	II	III	I	II	III
No. of animals at start of fattening	301	300	301	749	750	746
No. of animals at end of fattening	301	299	296	746	745	737
No. of dead animals	–	1	5	3	5	9
Mortality (%)	–	0.3	1.7	0.4	0.6	1.2
First day of fattening	19.12.2017	25.04.2018	19.08.2018	19.01.2018	27.03.2018	05.07.2018
Last day of fattening	22.03.2018	02.08.2018	14.12.2018	09.04.2018	25.06.2018	10.10.2018
Fattening period (season of the year)	winter	spring– –summer	summer– –autumn	winter	spring– –summer	summer– –autumn

TABLE 3. Average fattening results of experimental animals

Item	Housing system					
	Litter			Litterless		
	I	II	III	I	II	III
Initial weight (kg)	25.8	26.5	26.5	30.9	26.7	27.0
Weight of pig at slaughter (kg)	117.4	125.0	145.0	129.2	130.2	134.8
Fattening duration (days)	93	98	117	80	90	97
Total body weight gain (kg)	91.6	98.5	118.5	98.3	103.5	107.8
Daily gain (g)	986	1005	1013	1229	1150	1111
Feed intake during fattening (kg)	242.5	256.8	309.0	246.9	256.3	264.8
Daily feed intake (kg)	2.60	2.62	2.64	3.01	2.85	2.73
Feed conversion (kg feed/kg gain)	2.65	2.61	2.61	2.51	2.47	2.46

al. 2008). Different results were reported by Honeyman and Harmon (2003) in a study conducted in the summer and winter seasons. These authors found higher daily gains in the summer season in fattening pigs kept on deep litter in comparison with animal fattened in the litterless system, as well as comparable daily gains in the winter season.

Feed conversion (kg feed/kg gain) was slightly better in the litterless compared to the litter-based system (by 5%). The lower feed conversion was probably caused by the consumption of straw also, which is a fibre that reduces nutrient digestibility and absorption. In our study, feed conversion was 2.46–2.65 kg, which is considered very good compared to the

findings of Karpiesiuk and Falkowski (2008) and Taraska et al. (2016). The factors possibly responsible for the high feed conversion include well-balanced complete diets prepared on the farm, high genetic potential and high health status of the pigs.

In our study we found that meatiness of pork carcasses was high regardless of the season in which the animals were fattened. The mean meatiness of carcasses, regardless of their weight, was 57% (Table 4). We failed to confirm the relationship reported by Antosik and Koćwin-Podsiadła (2010) and Zybert et al. (2015) that carcass meatiness decreases as hot carcasses weight increases. The coefficient of correlation calculated by Antosik and Koćwin-Podsiadła (2010) suggests that an increase in hot carcass weight by 10 kg may be accompanied by a decrease in carcass meat content by around 2.8 p.p. In our study, even the carcasses heavier than 110 kg had a meatiness of 59%. A lack of differences in the meatiness of carcasses with different weights (less than 78 kg and over 92 kg) was also reported by Krzęcio et al. (2004).

In our study we observed that fattening pigs kept in the litter system were characterized by higher meatiness (by a maximum of 2.9%) compared to the pigs fattened in the litterless system (Table 4). This result could be related to the weight gains of the pigs. Bocian et al. (2015) report that the high growth rate of the pigs during fattening does not always result in favourable parameters of carcass slaughter value. Meatiness was highest (58.9%) in fatteners with the lowest daily gains (986 g), and lowest (56%) in fastest gaining pigs (1229 g). The authors determined the coefficients of phenotypic correlation between daily gains and the other fattening and slaughter traits. Although the coefficient of correlation between daily gains and meatiness was not significant, it assumed a negative value ( $R = -0.148$ ), which points to a negative relationship between these traits. That meatiness depends more on the growth rate than on the pig housing system (Gentry et al. 2002). In our study, slower growing animals with a lower daily feed intake (pigs fattened on litter system) were better muscled, which is indicative of better

TABLE 4. Average slaughter results

Item	Housing system					
	litter			litterless		
	I	II	III	I	II	III
Hot carcass weight (kg)	92.6	98.8	114.6	100.8	101.5	105.1
Dressing percentage	78.9	79.0	79.0	78.0	78.0	78.0
Meatiness (%)	58.9	58.7	58.8	56.0	57.8	57.9
Proportion of carcasses in different EUROP categories (%)						
S	24.0	30.0	32.0	8.0	32.0	37.0
E	64.0	58.0	65.0	60.0	64.5	59.0
U	12.0	12.0	3.0	29.0	3.0	3.0
R	–	–	–	3.0	0.5	1.0

utilization of dietary protein to support protein deposition in meat (Orzechowska et al. 2010). In both the litter and litterless systems, most of the carcasses (60%) were graded as class E. Meatiness was more uniform in animals raised in the litter system. The greatest differences in meatiness occurred in the group of fastest growing pigs that were kept in the litterless system in the winter period.

The profitability of fattener production depends largely on live pig procurement prices and production costs. The costs of production are primarily dependent on feed prices because feeding costs account for more than 50% of all fattening costs (Pepliński 2013, Bocian et al. 2015). Table 5 presents the production costs and simplified estimates of profitability in the two

housing systems. The production costs do not include daily handling costs (except for the costs associated with provision of bedding material and removal of manure twice a week), depreciation of buildings, and mortality costs. The production costs ranged from 500 to 576 PLN. The most important item in the structure of costs was the purchase of weaners, who presented from 39 to 53% and feed raw materials (from 42 to 56%). Animals were fattened to different slaughter weights (117.4–145.0 kg in the first and third fattening periods in the litter-based system, respectively), the weaners were purchased at various prices (211–302 PLN in the first and third fattening period in the litter-based system, respectively), but due to higher daily gains and lower feed

TABLE 5. Average results of economic analyses fattening pigs

Item	Housing system					
	litter			litterless		
	I	II	III	I	II	III
Costs (PLN/animal):						
Weaner	249.3	302.0	211.3	264.1	298.2	250.0
Feed	223.1	243.9	305.9	224.7	253.7	259.5
Veterinary services	5.0	5.0	6.0	5.5	5.5	6.0
Water, energy	5.0	6.0	6.0	6.0	6.5	7.0
Litter + labour involved	18.0	19.0	23.0	–	–	–
Total	500.4	575.9	552.2	500.3	563.9	522.5
Revenue (PLN/animal):						
Manure	20.0	22.0	30.0	–	–	–
Slurry	–	–	–	6.5	7.0	7.5
Carcass	561.3	612.6	580.0	593.7	618.1	605.4
Total	581.3	624.6	610.0	600.2	625.1	612.9
Revenue – costs (PLN/animal)	+ 80.9	+ 58.7	+ 57.8	+ 99.9	+ 61.2	+ 90.4
Cost 1 kg of body weight gain (PLN)	5.46	5.85	4.66	5.09	5.44	4.85
Profit from the sale of 1 kg of hot carcass weight (PLN)	0.87	0.59	0.50	0.99	0.60	0.86

conversion, better economic results were obtained for pigs kept in the litterless system. Difference totaled 0.16 PLN per 1 kg hot carcass weight.

## CONCLUSIONS

In summary, it is concluded that pigs kept in the litter system are characterized by lower daily gains, less efficient feed conversion and higher meatiness. Taking into account the costs incurred during the fattening process and revenue from the sale of fattening pigs and natural fertilizer, keeping the pigs without bedding proved more profitable. A potential consumer of pork obtained from pigs kept under improved welfare conditions, i.e. on litter, should pay more to compensate for the higher costs of production.

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- Streszczenie:** *Wpływ systemu utrzymania na wyniki tuczne i rzeźne oraz opłacalność tuczny świń.* Badania przeprowadzono w gospodarstwie utrzymującym tuczniaki w chlewni bezściołowej i ściółkowej. W każdym z systemów utrzymania przeprowadzono po 3 tucze warchlaków Landrace × Duroc importowanych z Danii o początkowej masie ciała 25–30 kg. Zwierzęta żywiono *ad libitum* mieszankami przygotowanymi w gospodarstwie. W badaniach określono śmiertelność zwierząt, przyrosty dobowe, zużycie paszy na 1 kg przyrostu masy ciała, dzienne pobranie paszy, masę tuszy ciepłej oraz mięsność. Przeprowadzono uproszczoną kalkulację ekonomiczną tuczny. Zwierzęta utrzymywane w systemie ściółkowym charakteryzowały się mniejszymi o 10–20% przyrostami dobowymi, mniejszym dobowym pobraniem paszy (5–10%), większym zużyciem paszy (5%) i większą mięsnością (1–2,9%). Uwzględniając koszty poniesione w okresie tuczny oraz przychody ze sprzedaży tuczników i nawozy naturalnego bardziej opłacalne okazało się utrzymanie świń w systemie bezściołowym. Różnica wynosiła 0,16 złotych na 1 kg tuszy ciepłej.
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