

PRODUCTION AND ECONOMIC ASPECTS OF CONVENTIONAL AND ALTERNATIVE PIG FATTENING

V. Margeta, Z. Tolušić, I. Kralik

Original scientific paper
Izvorni znanstveni članak

Paper is presented on the International Conference 6th Kábrt's Dietetic Days in Brno, 5 May 2005

SUMMARY

The aim of this research was to compare productive, slaughtering and economic characteristics of conventional and deep litter housing systems of pig fattening. The research was carried out on 105 crossbreeds (LW x GL) x GL, which were divided into three groups. Pigs of the first group were kept on straw-bedded floor, while the second group was kept on sawdust. The third group was kept in a conventional way, on solid floor, without straw bed. When compared to pigs kept on deep litter, pigs kept conventionally had higher live weight, better average daily weight gain and better food conversion during fattening. Pigs kept on deep litter had thinner back fat, greater portion of muscular tissue in carcasses and more favorable classification of carcasses to commercial classes than the pigs kept on sawdust and conventionally. Deep litter housing system provided better financial results than the conventional housing systems.

Key- words: *pigs, fattening, deep litter, conventional fattening, cost effectiveness*

INTRODUCTION

There is lately a noticeable trend to develop alternative pig production systems, which will meet requirements of animal welfare and environment protection, but will not affect the decrease in intensity and cost-effective production. Deep litter housing system is considered to be a possible solution to these requests, because of which it becomes very popular way of pig keeping in well-developed agricultural countries. Many research results point out advantages of deep litter housing system, however, there are also some disadvantages of such system if compared to the conventional housing system. When compared to the conventional housing system, many scientists agree that there is a cost benefit of deep litter housing system, as it is cheaper (Gentry et al., 2002a, Morrison et al., 2003a, Kralik et al., 2004), and more favorable for animal welfare and environment protection (Lyons et al., 1995, De Jong et al., 1998, Beattie et al., 2000, Kelly et al., 2000, Klont et al., 2001, Guy et al., 2002, Morrison et al., 2003b, Margeta et al., 2004). Considering productivity and slaughtering characteristics of finishing pigs, the majority of authors point out not only advantages of deep litter housing system (Beattie, 1996; Morgan et al., 1998; Beattie et al., 2000; Spoolder et al., 2000; Turner et al., 2000; Klont et al., 2001; Maw et al., 2001; Lombooij et al., 2004), but also some negative effects that this way of pig housing has on the above mentioned characteristics (Gentry et al., 2002b; Honeyman and Harmon, 2003; Morrison et al., 2003a, 2003b). Different research results show that many factors other than a housing system affect the productivity and slaughtering characteristics of finishing pigs to some extent.

MATERIAL AND METHODS

MSc Vladimir Margeta, DSc Zdravko Tolušić, Associate Professor and Igor Kralik, BEc - Faculty of Agriculture, Josip Juraj Strossmayer University of Osijek, Trg sv. Trojstva 3, 31000 Osijek

The research was carried out on 105 crossbreeds (LW x GL) x GL, which were divided into three groups. Pigs of the first group were kept on straw-bedded floor, while the second group was kept on sawdust. The third group was kept in a conventional way, on solid floor, without straw bed. Pigs in each group were fed equally. In the first fattening phase (up to 60 kg), pigs were fed a mixture that contained 16% of crude proteins and 13.0 MJ/kg ME; while in the second phase of fattening (60-110 kg) that mixture contained 14% of crude proteins and 13.0 MJ/kg ME. Throughout the fattening period, the average daily weight gain and costs of live weight gain were calculated and the food consumption and conversion were controlled. Meat portion (M%) in carcasses was obtained during slaughtering by applying the “two points” method (Rule Book, 1999, 2001), based on the following formula:

$$M\% = 47.978 + 26.0429 \frac{S}{M} + 4.5154\sqrt{M} - 2.50181 \log_{10} S - 8.4212\sqrt{S}$$

S- thickness of fat with skin (in mm) on the midline of the split carcass, covering the lumbar muscle (*M. gluteus medius*), M = the visible thickness of the lumbar muscle (in mm) on the midline of the split carcass, measured at the shortest connection between the front (cranial) end of the lumbar muscle and the upper (dorsal) edge of the vertebral canal.

According to the obtained meat portion values, the carcasses were divided into the (S)EUROP commercial classes. Costs of housing, feeding, health protection, as well as other costs related to specific conditions were taken into consideration in order to determine economic indicators of different housing systems.

RESULTS AND DISCUSSION

At the beginning of fattening process, live weight of growing pigs kept on deep litter was almost the same (27.48 kg and 27.71 kg, respectively), while pigs kept without deep litter had highly significantly ($P < 0.001$) less live weight (23.43 kg). This difference is due to pig selection on a farm, being housed firstly in deep litter pens, and lastly in ones without deep litter beds, which resulted in pigs of less weight being kept on solid floor. Fattening of pigs on straw-bedded floor lasted 117 days, and fattening in conventional and sawdust conditions lasted 118 days. At the end of fattening, pigs without deep litter had highly significantly ($P < 0.001$) higher finishing weights (110.7 kg) than pigs kept on sawdust (101.7 kg), and significantly higher ($P < 0.05$) than pigs kept on deep litter (106.7 kg). When considering finishing weights, statistically significant differences ($P < 0.05$) were established between groups kept on deep litter and on sawdust (Table 1). Pigs kept on deep litter had significantly higher ($P < 0.05$) average daily weight gain (0.678 kg) than pigs kept on sawdust (0.627 kg). However, daily weight gain of pigs kept conventionally, without straw bed, was highly significantly ($P < 0.001$) higher (0.739 kg) than of pigs kept on sawdust, and significantly higher ($P < 0.05$) than of pigs kept on deep litter. The least food consumption per kg of live weight gain was noticed in pigs that were kept conventionally (3.02 kg), followed by the pigs kept on deep litter (3.12 kg) and then by pigs kept on sawdust. There were statistically significant differences ($P < 0.05$) established between groups kept on sawdust and conventionally with respect to food consumption per kg of weight gain. Mortality rates did not differ significantly between groups kept on deep litter (2.86%), however, when compared to them, pigs without deep litter had statistically highly significant ($P < 0.001$) mortality rate during fattening (8.58%). Monitoring of pig behavior during fattening period resulted in conclusion that pigs kept on deep litter spent more time moving around and were less aggressive than the pigs without deep litter. These conclusions correspond with results stated by De Jong et al. (1998), Kelly et al. (2000), Turner et al. (2000), as well as Day et al. (2002) and Morrison et al. (2003a). Not only productive, but also slaughtering characteristics significantly affect the effectiveness and cost benefit of pig production. Beattie et al. (2000) stated that finishing pigs kept on deep litter had better food conversion, less food consumption per kg of live weight gain, better weight gain, and thicker back fat when compared to pigs that were kept in a conventional way. Lambooij et al. (2004) found out that the pigs kept on deep litter had significantly higher weight of warm carcasses and better water holding capacity. Honeyman and Harmon (2003) found out that, in comparison to the pigs kept on half-cross-barred floor, pigs kept on deep litter had higher average weight gain in the summer months, while in the winter months, they had equal average daily gain, but weaker conversion. In comparison to pigs

kept conventionally, Kralik et al. (2004) determined the pigs kept on deep litter to have better food consumption and food conversion, heavier warm carcasses, thinner back fat and greater portion of muscular tissue in carcasses. Moreover, classification of carcasses was in favor of deep litter housing system, as greater portions of carcasses of pigs kept on deep litter were classified as S and E, than of those pigs in conventional housing system.

Table 1. Data of fattening productivity

Tablica 1. Proizvodni pokazatelji u tovu

Production indicators <i>Proizvodni pokazatelji</i>	Housing system - <i>Držanje svinja</i>		
	Deep litter (straw) <i>Stelja (slama)</i>	Deep litter (sawdust) <i>Stelja (piljevina)</i>	Conventional <i>Klasično</i>
	A	B	C
Beginning of fattening, no. of pigs <i>Početak tova, kom</i>	35	35	35
End of fattening, no. of pigs <i>Kraj tova, kom</i>	34	34	32
Fattening period, days <i>Trajanje tova, dana</i>	117	118	118
Starting weight, kg <i>Težina na početku, kg</i>	27.48 ^{**C}	27.71 ^{**C}	23.43 ^{**A,B}
End weight, kg <i>Težina na kraju, kg</i>	106.7 ^{*B,C}	101.70 ^{*A,**C}	110.70 ^{*A,**B}
Total weight gain, kg <i>Prirast ukupni, kg</i>	79.22 ^{**B,C}	73.99 ^{**A,C}	87.27 ^{**A,B}
Average weight gain, kg <i>Prosječni prirast, kg</i>	0.678 ^{*B,C}	0.627 ^{*A,**C}	0.739 ^{*A,**B}
Food/FD, kg - <i>Hrana/HD, kg</i>	2.11 ^{*B,C}	1.99 ^{*A,**C}	2.23 ^{*A,**B}
Food/kg of gain - <i>Hrana/kg prirasta</i>	3.12	3.17 ^{*C}	3.02 ^{*B}
Mortality, % - <i>Mortalitet, %</i>	2.86 ^{**C}	2.86 ^{**C}	8.58 ^{**A,B}

* P<0.05, ** P<0.001

Slaughtering characteristics of carcasses refer to thinner back fat and higher portion of muscular tissue of pigs kept on deep litter than of pigs kept on sawdust and in a conventional way (Table 2). Classification of carcasses resulted in the highest portion of the S and E classes to be given to pigs kept on sawdust (79.42%), which can be explained by their weaker weight gain and smaller live weights during fattening. The least portion of the S and E commercial classes had carcasses of pigs kept without deep litter (53.12%). Pigs in deep litter housing system had not only the best average meatiness, but also the most favorable commercial classification, as none of their carcasses was marked as the R class. Similar results were stated by Kralik et al. (2004). However, Klont et al. (2001) and Gentry et al. (2002a) did not find differences in meatiness between pigs in conventional and deep litter housing systems. Based on the analysis of economic aspects of housing systems, it was concluded that the deep litter housing system gave the best financial results. The second best financial result was of the sawdust housing system, while the conventional housing system did not prove financially successful in comparison to the previous two systems (Table 3). These results are based on the lowering of costs per finishing pig, and gaining the better market price of the product, as well as on the value of produced fertilizer. Similar conclusions were made by Gentry et al. (2002a) and Morrison et al. (2003a) and Kralik et al. (2004). The most important prerequisites to productivity and profitability of pig production refer to the lowering of costs per finishing pig, retaining at the same time its satisfactory quality.

Table 2. Slaughtering characteristics of carcasses
Table 2. Pokazatelji klaoničkih svojstava svinjskih trupova

Commercial classes <i>Trgovačke klase</i>	%	Pig weight <i>Težina svinja</i> (kg)	Average S <i>Prosjek S</i> (mm)	Average M <i>Prosjek M</i> (mm)	Meatiness <i>Mesnatost</i> %
Deep litter (straw) – Duboka stelja (slama)					
S	38.60	79.27	8.61	71.01	62.36
E	38.54	82.11	13.50	72.35	57.44
U	22.86	82.68	18.32	66.90	52.69
Total - <i>Ukupno</i>	100.00	81.35	13.47	70.08	57.49
Deep litter (sawdust) – Duboka stelja (piljevina)					
S	58.82	78.11	6.50	70.70	65.32
E	20.60	83.01	12.29	66.71	57.45
U	11.76	84.84	18.00	69.00	53.44
R	8.82	86.00	26.67	67.00	48.32
Total - <i>Ukupno</i>	100.00	82.99	15.86	68.35	56.13
Conventional housing - Držanje klasično na podu					
S	43.75	79.13	6.29	72.71	65.92
E	9.37	81.00	13.00	69.67	57.55
U	40.62	84.14	18.00	68.31	53.36
R	6.26	85.58	24.50	64.50	48.99
Total	100.00	82.46	15.44	68.79	56.45

Table 3. Cost benefit analysis of two different housing systems (with and without deep litter)
Table 3. Kalkulacija prihoda i rashoda dvaju različitih načina tova svinja (sa steljom i bez stelje)

Structure of income and expenses <i>Struktura prihoda i rashoda</i>	Value of pig - <i>Vrijednost po tovljeniku</i> (EUR)		
	Deep litter – <i>Duboka stelja</i>		Conventional housing <i>Klasično držanje</i>
	Straw - <i>Slama</i>	Sawdust - <i>Piljevina</i>	
1. Expenses - <i>Rashodi</i>			
Growing pig – <i>Prasad za tov</i>	33.35	33.35	33.35
Food - <i>Hrana</i>	42.00	39.90	44.70
Veterinary costs – <i>Veterinarski troškovi</i>	6.00	6.00	8.00
Other costs – <i>Ostali troškovi</i>	6.65	6.65	6.65
Deep litter – <i>Stelja</i>	1.85	1.65	-
Expenditures Total - <i>Ukupno rashodi</i>	89.85	87.55	92.70
2. Income - <i>Prihodi</i>			
Fattened pig – <i>Isporučeni tovljenik</i>	170.10	169.45	169.30
Fertilizer – <i>Gnoj</i>	10.00	3.00	-
Income Total - <i>Ukupno prihodi</i>	180.10	172.45	169.30
Profit – <i>Dobit</i> (2.– 1.)	90.25	84.90	76.60

CONCLUSION

Based on the obtained results, it can be concluded that pigs, which were kept conventionally had better production results (higher live weight, better average daily weight gain, better food conversion) than pigs kept on deep litter. Slaughtering characteristics pointed out thinner back fat and greater portion of muscular tissue in carcasses of pigs kept on deep litter than of pigs kept conventionally and on sawdust. Furthermore, classification of warm carcasses was in favor of pigs kept on deep litter. Classification was the worst in pigs kept conventionally. In comparison to the conventional pig housing, better financial results were obtained by deep litter housing system, mostly because of lowered costs and higher market price of final products, i.e. of finishing pigs.

REFERENCES

1. Beattie, V.E., Walker, N., Sneddon, I.A. (1996): An investigation of the effect of environmental enrichment and space allowance on the behaviour and production of growing pigs. *Applied Animal Behaviour Science* 48:151-158.
2. Beattie, V.E., O'Connell, N.E., Moss, B.W. (2000): Influence of environmental enrichment on the behaviour, performance and meat quality of domestic pigs. *Livestock Production Science* 65:71-79.
3. Day, J.E.L., Burfoot, A., Docking, C.M., Whittaker, X., Spooler, H.A.M., Edwards, S.A. (2002): The effects of prior experience of straw and the level of straw provision on the behaviour of growing pigs. *Applied Animal Behaviour Science* 76:189-202.
4. De Jong, I.C., Ekkel, E.D., Van de Burgwal, J.A., Lambooi, E., Korte, S.M., Ruis, M.A.W., Koolhaas, J.M., Blokhuis, H.J. (1998): Effects of strawbedding on physiological responses to stressors and behaviour in growing pigs. *Physiology & Behavior* 64:303-310.
5. Gentry, J.C., McGlone, J.J., Miller, M.F., Blanton, J.R. Jr. (2002a): Diverse birth and rearing environment effects on pig growth and meat quality. *J. Anim. Sci.* 80:1707-1715.
6. Gentry, J.C., McGlone, J.J., Blanton Jr., J.R., Miller, M.F. (2002b): Impact of spontaneous exercise on performance, meat quality, and muscle fiber characteristics of growing/finishing pigs. *J. Anim. Sci.* 80:2833-2839.
7. Guy, J.H., Rowlinson, P., Chadwick, J.P., Ellis, M. (2002): Health conditions of two genotypes of growing-finishing pig in three different housing systems: implications for welfare. *Livestock Production Science* 75:233-243.
8. Honeyman, M.S., Harmon, J.D. (2003): Performance of finishing pigs in hoop structures and confinement during winter and summer. *J. Anim. Sci.* 81:1663-1670.
9. Kelly, H.R.C., Bruce, J.M., English, P.R., Fowler, V.R., Edwards, S.A. (2000): Behaviour of 3-week weaned pigs in Straw-Flow[®], deep straw and flatdeck housing systems. *Applied Animal Behaviour Science* 68:269-280.
10. Klont, R.E., Hulsegge, B., Hoving-Bolink, A.H., Gerritzen, M.A., Kurt, E., Winkelman-Goedhart, H.A., De Jong, I.C., Kranen, R.W. (2001): Relationships between behavioral and meat quality characteristics of pigs raised under barren and enriched housing conditions. *J. Anim. Sci.* 79:2835-2843.
11. Kralik G., Romić Z., Tolušić, Z., Margeta V. (2004): Effects of housing systems on carcass characteristics of finishing pigs. *Proceedings of 50th International Congress of Meat Science and Technology*, 8-13 Aug. 2004, Helsinki, Finland, CD, Session 2: Meat Quality, p. 431-434 Abstracts, p. 90.
12. Lambooi, E., Hulsegge, B., Klont, R.E., Winkelman-Goedhart, H.A., Reimert, H.G.M., Kranen, R.W. (2004): Effects of housing conditions of slaughter pigs on some post mortem muscle metabolites and pork quality characteristics. *Meat Science* 66:855-862.
13. Lyons, C.A.P., Bruce, J.M., Fowler, V.R., English, P.R. (1995): A comparison of productivity and welfare of growing pigs in four intensive systems. *Livestock Production Science* 43:265-274.
14. Margeta, V., Kralik, G., Antunović, B. (2004): Tov svinja na dubokoj stelji. *Zbornik radova XI. međunarodnog savjetovanja Krmiva 2004*, 01.-04.06.04., Opatija, str. 61.-66.
15. Maw, S.J., Fowler, V.R., Hamilton, M., Petchey, A.M. (2001): Effect of husbandry and housing of pigs on the organoleptic properties of bacon. *Livestock Production Science* 68, 119-130.
16. Morgan, C.A., Deans, L.A., Lawrence, A.B., Nielsen, B.L. (1998): The effects of straw bedding on the feeding and social behaviour of growing pigs fed by means of single-space feeders. *Applied Animal Behaviour Science* 58, 23-33.
17. Morrison, R.S., Hemsworth, P.H., Cronin, G.M., Campbell, R.G. (2003a): The social and feeding behaviour of growing pigs in deep-litter, large group housing systems. *Applied Animal Behaviour Science* 82:173-188.
18. Morrison, R.S., Hemsworth, P.H., Cronin, G.M., Campbell, R.G. (2003b): The effect of restricting pen space and feeder availability on the behaviour and growth performance of entire male

growing pigs in a deep-litter, large group housing system. Applied Animal Behaviour Science 83, 163-176.

19. Spoolder, H.A.M., Edwards, S.A., Corning, S. (2000): Legislative methods for specifying stocking density and consequences for the welfare of finishing pigs. Livestock Production Science 64:167-173.
20. Turner, S.P., Ewen, M., Rooke, J.A., Edwards, S.A. (2000): The effect of space allowance on performance, aggression and immune competence of growing pigs housed on straw deep-litter at different group sizes. Livestock Production Science 66, 47-55.
21. Rule Book on Categorization and Classification of Pig Carcasses and Halves. Official Journal No. 119/1999 and Amendments of the Rule Book. OJ No. 13/2001, of February 16, 2001.

PROIZVODNI I EKONOMSKI ASPEKTI KONVENCIONALNOG I ALTERNATIVNOG TOVA SVINJA

SAŽETAK

Cilj istraživanja bio je komparacija proizvodnih, klaoničkih i ekonomskih pokazatelja tova svinja koje su držane na dubokoj stelji i na konvencionalan način. Istraživanje je provedeno na 105 svinja križanaca (LW x GL) x GL koji su bile podijeljene u tri skupine. Za tov prve skupine kao stelja se koristila slama, a kod druge skupine drvena piljevina. Treća skupina držana je na klasičan način, na punom podu bez stelje. Svinje držane na klasičan način imale su veću živu težinu, veći prosječni dnevni prirasti i bolju konverziju tijekom tova u odnosu na svinje držane na stelji. Svinje držane u tovu na slami imale su tanju leđnu slaninu, veći udjel mišićnog tkiva u trupovima i povoljnije razvrstavanje trupova u trgovačke klase u odnosu na svinje držane na piljevini i u konvencionalnom tovu. Povoljniji financijski rezultat ostvaren je kod tova svinja na dubokoj stelji u odnosu na klasičan tov.

Ključne riječi: svinje, tov, duboka stelja, konvencionalan tov, ekonomičnost

(Received on 25 May 2005; accepted on 16 June 2005 - *Primljeno 25. svibnja 2005.; prihvaćeno 16. lipnja 2005.*)