FULL OR PARTIAL OUTDOOR REARING OF SLAUGHTER PIGS – EFFECTS ON PERFORMANCE, CARCASS QUALITY AND NUTRIENT LOAD

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Abstract
An experiment with slaughter pigs from weaning to slaughter including five treatments and five replicates was carried out at the Danish organic experimental station, Rugballegård. Treatments included full or partial outdoor rearing of the pigs, and the replicates covered the seasonal effects. Pigs fed *ad libitum* indoors had a significantly lower feed consumption (5 MJ ME /kg gain), a lower lean percentage (2.3% points), and a higher backfat depth (1.1 mm, $P < 0.05$) than pigs fed *ad libitum* outdoors. Compared with outdoor pigs fed *ad libitum,* restricted feeding outdoors resulted in a significantly lower daily gain (107 g), a lower feed consumption (6.3 MJ ME/kg gain), higher lean percentage (2.1% points), and a reduced backfat (1.8 mm) ($P <0.001$). The content of soil nitrogen was considerably higher than for the soil outside the paddocks. Despite a considerable variation within the paddocks, N was distributed throughout the paddock. The present investigation highlights the fact that outdoor rearing of organic finishers may be a competitive option even in a temperate climate and all year round.

Introduction
In many countries, including Denmark, organic pork production takes place in barns where the pigs have free access to a limited outdoor area. However, such housing is often very expensive and it may be questioned whether pigs reared under such conditions comply with consumer expectations of organic farming.

Alternatively, slaughter pigs can be reared outdoors. However, data on production results obtained from outdoor rearing are limited. In addition, in relation to the deposition of manure in the outdoor paddocks, outdoor rearing may have drawbacks such as an increased risk of nitrate leaching. Strategies that combine indoor and outdoor rearing may be preferable from an overall perspective.

The purposes of this investigation were to quantify differences in performance and carcass quality traits of pigs reared outdoors or indoors, and to highlight the risk of N-leaching from grass paddocks in such systems.

Methodology
The experimental design comprised five rearing strategies in five replicates using a group size of ten pigs that were balanced in terms of live weight and sex. Upon weaning at age 7-8 weeks (approx. 19 kg live weight) piglets born in an outdoor system were distributed over the five rearing strategies as follows:

1. Piglets were moved indoors at weaning and fed *ad libitum* until slaughter.
2. Piglets stayed on pasture and were fed restrictively with concentrates until 40 kg live weight, followed by *ad libitum* feeding in an indoor pen.
3. Piglets stayed on pasture and were fed restrictively with concentrates until 80 kg live weight, followed by *ad libitum* feeding in an indoor pen.
4. Piglets stayed on pasture until slaughter and were fed restrictively during the whole period.
5. As treatment 4, but the growers were fed *ad libitum* until slaughter.

The first replicate started in January 2002 and the fifth and last replicate was completed in April 2003, so that the seasonal variation was covered by the design.

In the field each experimental unit (group of ten pigs) was allocated to a 'new' piece of land, differing in size according to the expected nutrient load from the pigs. The stocking rate in the field was calculated to cause a level of excretion of 280 kg N per hectare. To ensure a good distribution of the manure and thereby the environmental load from the pigs on the pasture, the huts, troughs and water supply were moved on a regular basis.

All pigs were individually weighed at weaning, at transfer, and at slaughter. Soil samples where collected and grass cover evaluated each time pigs were transferred from the field to housing or slaughterhouse. Grid points were established for every 5x5 m in the 10 m wide paddocks and similarly points were established outside the paddocks for every 5 m as a reference. At each point soil samples were collected to 40 cm by pooling 8 soil cores. A total of 948 soil samples have been analysed for content of mineral N, exchangeable K and extractable P to determine the level and the distribution of nutrients within the paddocks.

Results

The content of soil nitrogen was considerably higher than for the soil outside the paddocks. Despite considerable variation within the paddocks, increased N levels were found throughout the paddock (Figure 1). Generally, it was difficult to maintain a grass cover in the paddocks. The nitrogen use efficiency in the paddocks (feed N input relative to animal N output) decreased the longer pigs were kept on the pasture. Thus, N in piglets kept outside until 40 kg accounted for 38% of feed N input, whereas N in piglets on pasture until slaughter accounted for only 30% of feed N input.

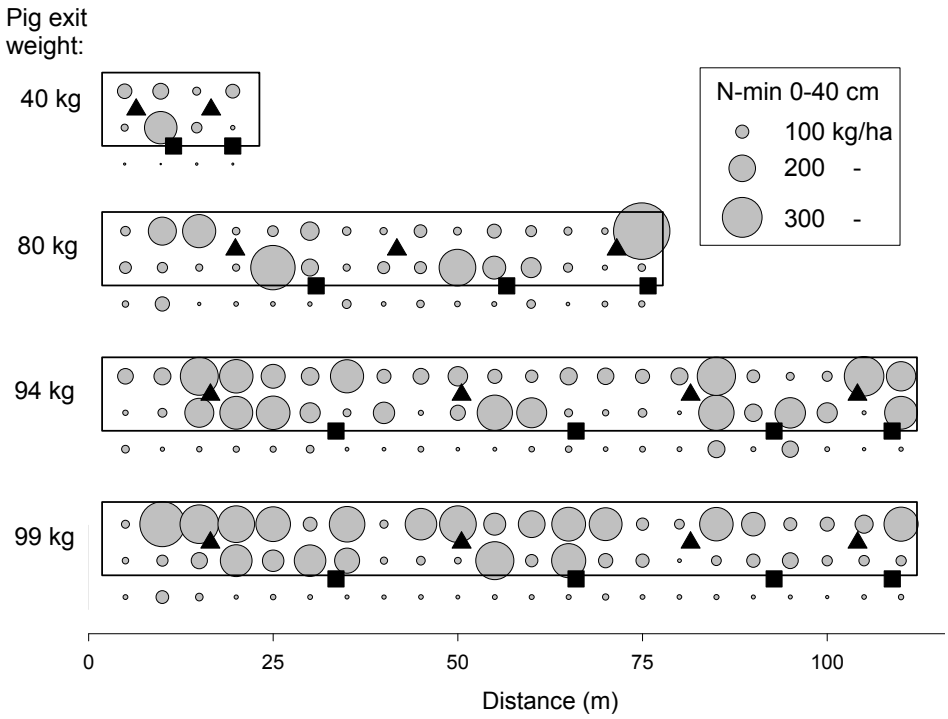

Fig.1. Bubble plot of inorganic soil nitrogen (0-40 cm) in and outside the four paddocks in replicate 4 of the experiment on growing pigs. Each paddock contained one hut (▲) and one feeding trough (■) that were moved every four weeks (from right to left). All positions throughout the experiment have been shown.

Performance traits of the pigs achieved in the five rearing strategies are given in Table 1.

The daily gain and age at slaughter were significantly affected by the weight/age at transfer indoors. The length of the pasture period with restricted feeding seemed directly related to a decrease in the overall daily gain in treatments IA, I40A, I80A and OR. However, the feed conversion rate was not significantly different among these treatments. Restrictively fed pigs had a higher age at slaughter (17 days), a lower daily gain (133 g), and an improved feed conversion rate (-6.3 MJ ME/kg gain).

Compared to the indoor-reared pigs (IA) the outdoor-reared pigs (OA) had a small numerically lower daily gain and a higher age at slaughter, while the feed conversion was significantly poorer (13.4%).

Pigs that were transferred at a live weight of 40 kg to indoor facilities with free access to feed compensated almost completely in overall daily gain before slaughter, while pigs transferred at 80 kg live weight only compensated a little.

The pigs reared on pasture had a significantly higher intake of roughage compared with indoor pigs. Although they had the possibility to graze and root, pigs reared outdoors with free access to concentrates consumed 85% more roughage than indoor pigs. This indicates a synergy between foraging and access to a variety of feeds in an enriched environment, as discussed by Andresen (2000).

Table 1. Performance traits achieved in five rearing strategies compared at the same live weight at slaughter; Least square means, SEM and *P* values for significance of differences between treatments.

Treatment	Indoor *ad lib* (IA)	Transfer to barn at 40 kg (I40A)	Transfer to barn at 80 kg (I80A)	Outdoor restricted (OR)	Outdoor *ad lib* (OA)	SEM	*P* value
Age at slaughter, days 1)	156 [a]	161 [a]	170 [b]	177 [b]	160 [a]	2.2	< 0.0001
Daily gain, g/day 1)	767 [a]	728 [a]	672 [b]	634 [b]	737 [a]	14	< 0.0001
Concentrate, kg per kg gain	2.81 [a]	3.03 [ab]	2.95 [ab]	2.64 [a]	3.15 [b]	0.12	< 0.05
Roughage, kg per kg gain	0.21 [a]	0.23 [a]	0.43 [b]	0.46 [b]	0.39 [b]	0.06	< 0.05
Feed conversion, MJ ME/kg gain	37.3 [a]	40.2 [ab]	39.9 [ab]	36.0 [a]	42.3 [b]	1.7	< 0.05

Different letters within each row indicates a significant difference (P < 0.05)
1) Adjusted to a final live weight of 97 kg

The carcass characteristics are given in Table 2.

Table 2. Carcass characteristics of pigs as a result of five rearing strategies; Least square means, SEM and *P* values for significance of differences between treatments.

Treatment	Indoor *ad lib* (IA)	Transfer to barn at 40 kg (I40A)	Transfer to barn at 80 kg (I80A)	Outdoor restricted (OR)	Outdoor *ad lib* (OA)	SEM	*P* value
Lean in total carcass, %	57.5 [a]	57.6 [a]	60.4 [b]	61.9 [c]	59.8 [b]	0.39	< 0.0001
Backfat depth, mm	17.6 [a]	18.4 [ab]	15.9 [d]	14.7 [e]	16.5 [ac]	0.51	< 0.001
Lean in central piece, %	61.9 [a]	61.4 [a]	65.4 [d]	67.3 [e]	64.2 [d]	0.57	< 0.0001

Different letters within a row indicate a significant difference (P < 0.05)

Rearing strategy had a significant effect on carcass traits (Table 2). Pigs reared outdoors throughout their life or until 80 kg live weight had a significantly higher meat content than pigs reared indoors. Backfat depth showed the opposite results. There were no significant differences in the lean percentage between I80A and OA pigs.

The effects on lean percentage and backfat corresponds to findings by Guy et al. (2002) and Stern et al. (2001). Gustafson & Stern (2003) and Gentry et al. (2002), however, found no such difference between indoor and outdoor pigs during the summer. An explanation could be that pigs on pasture use more energy during cold periods to maintain body temperature than indoor pigs with access to an outdoor pen.

Conclusion

The recorded differences in carcass characteristics in the present investigation resulting from the different rearing strategies can be very important in organic production. In some situations, such as in Danish organic production, the price achieved for a slaughter pig depends very much on whether the carcass fulfils certain quality threshold values, i.e. a minimum lean percentage and a maximum depth of backfat. The effect of this can turn out to be more important for the financial return in pig production than the achieved weight gain and cost of the feed. The present investigation highlights the fact that outdoor rearing of organic finishers may be a competitive option even in a temperate climate and all year round.

A risk of nitrogen leaching commensurate with stocking rate is inevitable. It is important to focus on a lowering of the level of dietary N to increase N use efficiency in outdoor slaughter pig production. However it was demonstrated that carefully planned movements of huts and feeding troughs made it possible to have an acceptable distribution of the nutrient load.

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