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The effect of wind shielding and pen position on the average daily weight gain and feed conversion rate of grower/finisher pigs

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ABSTRACT

Pigs are known to be particularly sensitive to heat and cold. If the temperature becomes too low, the pigs will grow less efficiently and be more susceptible to diseases such as pneumonia. If the temperature is too high, the pigs will tend to foul the pen, leading to additional risks of infection. Furthermore, unpublished data show that the temperature within a single section of grower/finisher pigs can vary considerably from pen to pen, and previous studies have shown that pigs can be significantly affected by wind, even when not directly exposed to it. To address this latter concern, some pig producers and research stations have implemented a shielding to prevent winds from blowing between separate sections of the pig housing buildings. However, according to our search of the literature, no published studies have ever investigated the effectiveness of such shielding.

To determine the significance of the effects of wind shielding, linear mixed models were fitted to describe the average daily weight gain and feed conversion rate of 1271 groups (14 individuals per group) of purebred Duroc, Yorkshire and Danish Landrace boars, as a function of shielding (yes/no), insert season (winter, spring, summer, autumn), start weight and interaction effects between shielding and start weight and shielding and insert season. Such a model was fitted separately to the data collected for each breed. Shielding was found to have significant interaction effects with season ($p=0.007$) and start weight ($p=0.0002$) for Duroc pigs, but no effect could be shown for Yorkshire or Danish landrace.

To determine the effect of a group's placement relative to the central corridor of a grower/finisher station, a similar model was fitted to the data for Duroc pigs, replacing shielding with distance from the corridor (1st, 2nd, 3rd or 4th pen). The effect could not be tested for Yorkshire and Danish Landrace due to lack of data on these breeds. For groups of pigs above the average start weight, a clear tendency of higher growth rates at greater distances from the central corridor was observed, with the most significant differences being between groups placed in the 1st and 4th pen ($p=0.0001$). A similar effect was not seen on smaller pigs. Pen placement appears to have no effect on feed conversion rate.

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No interaction effects between shielding and distance to the corridor could be demonstrated. Furthermore, in models including both factors, the effect of distance to corridor completely dominated over the effect of shielding, suggesting that shielding should at most be considered of secondary importance.

1. Introduction

Pigs are known to be more sensitive to heat and cold than, for example, cattle and will thus be more likely to expend energy to maintain a constant body temperature in response to varying surrounding temperatures (Young, 1981). This means that when exposed to temperatures below a critical threshold, the animal will expend energy on maintaining a constant body temperature rather than on growth. When wind is blowing, this threshold is significantly reduced, even if the pigs are not directly exposed to the blowing wind (Close et al., 1981; Mount, 1966). This is in line with the findings of Fitzgerald et al. (2009), who showed both the outside temperature and the wind speed to be significant factors relating to the risk of pigs arriving dead or exhausted after a transport to the abattoir, despite being shielded by the walls of the truck. Fitzgerald et al. (2009) found that low temperature generally increased the risk of pigs dying, while high wind speeds increased the risk during winter and reduced the risk during summer.

In addition to metabolism and stress, the temperature to which a pig is exposed can also affect the risk of infections. For example, lower temperatures increase the risk of pigs being infected with *Mycoplasma hyopneumoniae*, the bacterium which is the main causative agent of enzootic pneumonia and porcine respiratory disease complex (Segalés et al., 2012). Aside from being a welfare problem, such infections can significantly reduce the daily weight gain of the pigs, as demonstrated by Wilson et al. (2012). Also, it is known that pigs which experience temperatures above the limits of their comfort (typically 20–25 °C) will tend to foul the pen (Aarnink et al., 2006). The pigs will thus excrete in the resting area and rest in the dedicated excretion area of the pen, which can cause a series of potential health problems. Furthermore, currently unpublished data, given to us by the Danish research centre Foulum (AU Foulum 2013), show that within the same section of a pig production building, the temperature can vary considerably between individual pens.

Given the sum of the above information, it is meaningful to assume that certain areas of a given pig production building would pose problems for the growth and health of the pigs, which we expect would be evident from a slower average growth rate and/or less efficient utilization of the feed given to the pigs in those troublesome areas. Such troublesome areas might be pens with back walls exposed to the wind and temperature of the outside environment, or pens placed near the central corridor of a production building, as these will experience more draft. Based on the first of these assumptions, the Danish Pig Research Center (Danish Agriculture and Food Council, 2013) has put up wooden walls intended to provide shielding, preventing the wind from blowing between separate sections of Bøgildgård, their fish bone-shaped research and boar breeding station in Kjellerup, Denmark (see Fig. 1A). However, from our search of the scientific literature, there seem to be no studies examining the utility of such shielding, nor of the effect on the pigs being placed near the central corridor. A better understanding of the true effect of these factors would help farmers to make informed decisions about the best placement of pigs in terms of efficient production. Thus, the purpose of this study is to assess the effect of wind shielding and pen placement relative to a station's central corridor on average daily weight gain (ADG) and feed conversion rate (FCR). These primary predictive factors are examined in combination with the effects of varying seasons and pig start weight.

2. Materials and methods

This study was concerned with the effect on the main outcomes (ADG and FCR) at the level of the pen. Thus, ADG and FCR were first calculated for the individual pigs in the dataset, and subsequently the data was aggregated to the level of groups. We use the term “group” to mean up to 14 individual pigs, which are sharing the same pen during the same period of time. ADG and FCR were calculated at the individual pig level according to the following equations:

$$\mathrm{ADG} = \frac{\mathrm{Weight}_{End} - \mathrm{Weight}_{Insertion}\ (\mathrm{kg})}{\mathrm{Age}_{End} - \mathrm{Age}_{Insertion}\ (\mathrm{days})} \quad (1)$$

$$\mathrm{FCR} = \frac{\mathrm{Total\ feed\ consumption}\ (\mathrm{kg})}{\mathrm{Weight}_{End} - \mathrm{Weight}_{Insertion}\ (\mathrm{kg})} \quad (2)$$

The aggregation of ADG and FCR to group level was then done according to the following equations:

$$\mathrm{Group\_ADG} = \frac{\sum_{i=1}^{i=N_{group}} \mathrm{ADG}_i}{N_{group}} \quad (3)$$

$$\mathrm{Group\_FCR} = \frac{\sum_{i=1}^{i=N_{group}} \mathrm{FCR}_i}{N_{group}} \quad (4)$$

where ADG_i and FCR_i are the ADG and FCR values for the ith pig in the group respectively and N_{group} is the number of pigs in the group.

2.1. Source and study population

This study was done using data collected at the Danish research station Bøgildgård (Danish Agriculture and Food Council, 2013), primarily used for boar breeding. The study population was purebred grower/finisher pigs (30–100 kg)