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Relationship between feed, water intake, and body weight in gestating sows

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ABSTRACT

The aim of the present research was to analyse the relation between the traits feed (FI), water intake (WI), water-to-feed ratio (WFR) and weight of sow (WS) during pregnancy. Data were recorded at the Hohenschulen research farm of the Institute of Animal Breeding and Husbandry of the University of Kiel between April 2007 and June 2008. The sow herd had a size of 90 sows (Large White, German Landrace and their crossbreeds). In total about 8500 observations were available. The average feed, water intake, water-to-feed ratio and weight of sow were 2.9 kg d^{-1}, 16.7 l d^{-1}, 5.8 l (kg d)$^{-1}$ and 219.1 kg, respectively. Parity class had a significant influence on water and feed intake ($p<0.05$). Nulliparous sows had a constant water intake until day 80 of pregnancy. Thereafter water intake increased until the end of pregnancy. Water intake of primiparous sows increased at the beginning and end of pregnancy. The feed intake curves started without variation between sows at the beginning of the observation period. An increase was observed at the end of pregnancy. Weight of sow increased during pregnancy. Nulliparous sows had the highest weight gain and multiparous sows the lowest (39.0 kg and 23.8 kg respectively). Repeatabilities with the fixed regression model varied between 0.56 (FI) and 0.68 (WS). Using random regression the repeatability of feed intake increased continuously over the course of pregnancy from 0.35 to 0.75 indicating that the variance between sows at the beginning was lower than at the end of pregnancy. The repeatabilities of water intake enhanced from 0.57 to 0.75. The correlations between feed and water intake were constant until day 60 of pregnancy. The relationship decreased at the end of pregnancy due to feed adaptation. A negative relationship was found between feed intake and weight of sow but the value increased over the course of pregnancy.

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1. Introduction

Adequate water and feed intake are important for sow health (Neil et al., 1996), performance and reproduction (Koketsu et al., 1997). Several studies have observed the feed intake of rearing gilts (Le Cozler et al., 1999) and lactating sows (Eissen et al., 2000; Eissen et al., 2003; Koketsu et al., 1996; Kruse et al., 2010; Neil, 1996; Peng et al., 2007). Investigation of the water intake of gestating sows is rare in literature. Friend (1971) recorded the water intake per week of individually housed sows over two parities. The average water intake of pregnant sows was 7.6 l d^{-1}. A decrease from around 60 to 40 l per week after mating was observed. No literature has been found on the water intake of pregnant loose-housed sows. Feed and water intake are closely related. Friend (1971) calculated the water-to-feed ratio per week (2.46 to 2.07 and 2.74 to 1.92 for gilt and sow, respectively). The results showed a decreasing pattern during pregnancy.

Weight of sows was recorded in many studies (Neil, 1996; van der Peet-Schwering et al., 1998; Kranendonk et al., 2007) but without observing the relation to water intake or feeding in dynamic sow groups.

The aim of the present research was to analyse the relation between the traits feed, water intake, water-to-feed ratio and weight of gestating sows. The second objective was to establish whether the relationships remained constant during the course of pregnancy. To analyse this, fixed and the random regression models were used.

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2. Materials and methods

2.1. Animals and housing

Data were recorded at the Hohenschulen research farm of the Institute of Animal Breeding and Husbandry of the University of Kiel between April 2007 and June 2008. The observed sow herd had a size of 90 sows (Large White, German Landrace and their crossbreeds) in parities 1 to 7. A total of 90 sows with 144 pregnancies were available (about 8500 observations). The average group size was 26 sows. The sows were moved into the gestating unit around day 30 after ultrasonic pregnancy diagnosis. The compartment (7.20×9.10 m) had a running area with (a) slatted floor, an electronic sow feeder, two nipple drinkers and resting areas (three subunits per side) with a concrete floor (Fig. 1).

2.2. Recorded traits

The feed intake of the sows was recorded on a daily basis. Each sow had an individual demand of feed that was adapted to its parity and individual body condition. The body condition was scored from 1 (lean) to 5 (fat). The mean body condition was 3.5. Sows were able to take feed in a single meal or divide it into more meals. The feeding started every morning at 06:00 h. Feed was provided by an electronic sow feeder, the feeder was located in the middle of the running area and had two feeding units (Fig. 1). Sows were able to displace sows from the feeding station (open feeding station). The sows received a commercial gestating meal (15.2% crude protein, 5.2% crude fat, 7.2% crude fibre, 12.4 MJ ME/kg DM) according to the German norm (GfE, 2006). The diet included barley and wheat as the main ingredients.

Sows had free access to water. Two nipple drinkers with electronic identification by ear tacks were located at the end of the running area. The individual water intake was measured by a water flowmeter that was connected to a computer. The computer recorded the sow number, the beginning and the end of water intake as well as the amount of water.

The water-to-feed ratio was calculated by dividing water intake by feed intake. Sows were weighed and checked for pregnancy every month.

Extreme values that deviated more than ±4 s.d. from the mean of the measured data were excluded from the datasets, i.e. 91 and 12 observations of the traits water intake and water-to-feed ratio were removed. Average feed, water intake, water-to-feed ratio and weight of sow were 2.9 kg d^{-1} ($n=8675$), 16.7 l d^{-1} ($n=8557$), 5.8 l (kg d)$^{-1}$ ($n=8486$) and 219.1 kg ($n=471$), respectively.

2.3. Statistical analysis

Preliminary investigations were performed using SAS (2005) in order to analyse the fixed effects. The fixed regression model contained the fixed effects parity class and test day and the curve of day of gestation within parity class and the random effects sow and residual. The test day was included as a common test day and parity was divided into four classes of sows: nulliparous (31), primiparous (49), biparous (34) and multiparous (30). The curve of day of gestation was modelled by the function of Ali and Schaeffer (1987). The significance of fixed effects was tested by the F-test implemented in the Mixed Procedure in SAS (2005). The significance of differences in the least square means (LSQ-means) was adjusted with the Bonferroni-correction in the Mixed Procedure in SAS (2005). With regard to preconditions for linear models, homogeneity of variance was checked by plots of the standardised residuals against the predicted values. All residuals were normally distributed and their variance was homogeneous over the whole range of the predicted estimates. To answer the question of whether the variance components varied depending on day of gestation, a random regression model was used to model the sow-specific gestation curves applying a quadratic function. Repeatability was estimated univariately within the traits. The estimation of the correlation between the traits was performed bivariately. For the fixed and random regression model, the variance components were estimated by REML using the software package VCE5 (Kovac et al., 2002).

Random regression model:

$$y_{ijkl} \quad TD_i + PC_j + \sum_{m=1}^{4} b_{jm} * x_{ijklm}(d) + \sum_{m=1}^{2} s_{km} * x_{ijklm}(d) + e_{ijkl}$$

y_{ijkl} the observations of feed (kg d^{-1}), water intake (l d^{-1}), water-to-feed ratio (l kg^{-1} d^{-1}), and weight of sow (kg)

TD_i the fixed effect of the ith test day ($i=1,..,435$ for feed, water intake and water-to-feed ratio), ($i=1,..,45$ for weight of sow)

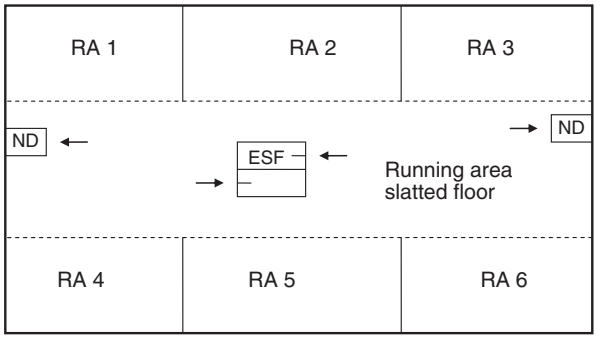

Fig. 1. Gestating unit with 6 resting areas, 2 electronic sow feeders and 2 water stations RA 1–6: resting area with concrete floor; ESF: electronic sow feeder; and ND: nipple drinker.

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