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55th Annual Meeting of the European Association for Animal Production
Bled, Slovenia
September 5th-9th, 2004

Feed intake behaviour of different pig breeds during performance test on station

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In Austria pigs are tested for growth and carcass traits centrally at one performance test station called "Österreichische Schweineprüfanstalt GmbH" in Lower Austria. In order to keep the pigs under conditions that are close to housing conditions on commercial farms they are kept in group pens (maximum 13 pigs per pen) and each pen is equipped with an electronic feeding station. The identity of the pig, date, feeder entry and exit time and the amount of feed consumed are recorded for each visit in the feeding station. In this study feed intake behaviour of 1.593 pigs of three different breeds (618 Large White, 486 Landrace, 489 Pietrain) was analyzed. Different traits such as visits per hour and per day, time in the feeding station per hour and per day, feed intake per hour and per day and feed consumption rate were used to describe feed intake behaviour for the observation periods testing day and testing period. By using Generalized Linear Models differences in feed intake behaviour between the breeds were assessed. LS-Means were used to describe feed intake patterns for each breed. Another aim of the study was to investigate the effects of MHS-type on feeding patterns of Pietrain.

1. Introduction

The study of feeding behaviour has relevance to a number of scientific disciplines and an array of techniques has been developed for its measurement (Young, 1993). Since the late 1980s electronic feeding stations are increasingly used in the field of pig breeding (Felde, 1996). Computerised feed intake recording systems have been developed to improve the accuracy of genetic selection. Such new techniques allow to measure feeding behaviour of individuals fed in groups under ad libitum conditions at low cost per measurement (Webb et al., 1990). Therefore group housing and ad

libitum feeding became more and more established on performance test stations in Europe (Felde et al., 1996) leading to testing conditions closer to the housing systems on commercial farms.

Several researchers investigated feeding behaviour of pigs based on records from such electronic feeding stations (De Haer and Merks, 1992; De Haer and De Vries, 1993; Young and Lawrence, 1994; Felde, 1996; Hyun et al., 1997; Hall et al., 1999a; Hall et al. 1999b; Schulze, 2001). Generally, the absolute values for feed intake traits vary largely between different studies, because feeding behaviour is influenced by many factors like genotypes, sexes, live weight ranges, pen designs, stocking densities, group sizes, feed form and environmental conditions (Hyun et al., 1997).

Hall et al. (1999a) investigated genetic and phenotypic parameters for feeding pattern and performance test traits in Large White pigs. They state that feeding patterns may be changed substantially by selection and genetic correlations with performance test traits indicate that feeding pattern traits can be usefully incorporated in selection criteria to improve somewhat the accuracy of selection. Huisman and Arendonk (2004) conclude that changes in feed intake patterns through selection are possible.

The aim of this study was to compare feed intake behaviour of the two main dam breeds in Austria, Large White and Landrace, and to clarify whether there is an effect of MHS-type on feeding patterns in Pietrain.

2. Data and methods

2.1. Data

Austrian pork production is based on crossbreeding programmes with Large White and Landrace as dam breeds and Pietrain as sire breed. Purebred pigs are tested for growth and carcass traits centrally at one performance test station. The performance test is carried out with male castrates in Large White and Landrace and with females of Pietrain. Piglets are brought to the test station with an average live weight of 6 to 12 kg and kept in groups of variable size. The performance testing starts at a 30 kg live weight. The pigs are divided into groups of 10 to 13. From the year 2000 the animals have been kept in group pens. Each pen is equipped with an electronic feeding station. During the testing period Large White and Landrace animals are kept in mixed groups while Pietrain is tested separately. The trial ends with a live weight of 106 kg for Large With and Landrace and 110 kg in case of Pietrain. Animals reach

those live weights after roughly 90 days. A standard pelleted growers feed was used, each kilogram containing 13.3 MJ of digestible energy, 18.2% crude protein, 6.1% crude fat and 4.2% crude fibre.

Feed intake behaviour of 1,593 pigs of three different breeds (618 Large White, 486 Landrace, and 489 Pietrain) recorded between May 2001 and May 2002 was analyzed. In total 3'668,788 visits in the electronic feeding station were registered. When a pig visited the feeding station it was identified by its transponder tag, entry and exit times and the amount of feed consumed were logged by a control box and subsequently transferred to a personal computer. Records of this type were generated continuously by individual pigs.

Data were prepared and analysed with the programme package SAS (1999). Thirty three records had to be excluded due to an impossible (negative) feeder occupation time per visit. Furthermore, visits with less than 3 g feed intake were not considered. After this first preparation of behaviour data 3'502,523 records were left for further analysis: 1'735,960 for Large White, 865,237 for Landrace and 901,326 for Pietrain. Based on these records the following feed intake behaviour traits were generated:

1) Number of visits in the feeding station per hour (NVF-H) and per test day (NVF-TD),
2) Time in the feeding station per hour (TF-H) and per test day (TF-TD),
3) Feed intake per hour (FI-H) and per test day (FI-TD) and
4) Consumption rate in g/min (CR).

2.2. Models

Generalized linear models were defined to investigate the feed intake behaviour during the observation periods test day (24 hours) and testing period (112 days). Model and results for monthly profile are not published, because data from just 13 months were available, which do not allow a general statement about seasonal effects. For this purpose behaviour data recorded over several years should be considered. Further a model was set up to compare feed intake patterns of Pietrain pigs with different MHS types.

Model 1: Feed intake behaviour during a test day – 24 hour profile

Model 1 was used to investigate which factors influence the number of visits in feeding station per hour, time in the feeding station per hour, feed intake per hour

and consumption rate (g/min). The following fixed main effects were included in the model: the effect of hour (24 hours), the effect of test day period (test days were merged into units of 5 days, resulting in 23 test day periods), effect of quarter year and the effect of breed. In addition all two-way interactions between main effects were tested.

Model 2: Feed intake behaviour during testing period – 112 day profile

Model 2 serves to describe the feed intake behaviour of growing pigs during the testing period. Therefore, single records were summed up to the variables: number of visits in the feeding station per testing day, time in the feeding station per testing day and feed intake per test day. Consumption rate (g/min) was also investigated with the following model. The maximum length of testing period was restricted to 112 days. A low number of animals (8 Landrace and 131 Pietrain pigs) reached the aimed live weight after 112 days and were therefore excluded from the analysis.

In this model the fixed effects of test day (112 test days), quarter year and breed were tested. Again all two-way interactions between main effects were included.

Model 3: Effect of the MHS type in Pietrain

With this model the influence of the MHS type in Pietrain pigs on average number of visits per test day, average time in the feeding station per test day and average feed intake per test day and the consumption rate (g/min) were investigated. For this analysis data on the MHS genotype of each animal were available coded as PP, NP, NN (results of MHS test) and PP*, NP* and NN* (inferred from MHS genotype of parents). Due to low frequencies for some genotypes (PP*: 0, NN: 4 and NN*: 11) two MHS types were built describing animals as stress susceptible (PP) or stress resistant (NP, NP*, NN, NN*). In total 488 animals were used for this analysis, 220 classified as stress susceptible and 268 as stress resistant. This model is similar to model 2 but instead of the fixed effect breed the fixed effect of MHS type was tested.

3. Results and discussion

3.1. Feed intake behaviour during test day – 24 hour profile

The test of the global hypothesis with regard to influence of breed on feed intake behaviour showed a highly significant breed effect on all behaviour traits investigated ($P<0.0001$). Large White animals showed the highest activity with 1.28 visits of the

feeding station per hour, followed by Landrace with 0.88 and Pietrain with 0.78. However Landrace animals spent more time per hour in the feeding station (2.74 min) and consumed more feed per hour (98g) than Large White (2.56 min; 95g) and Pietrain (2.37 min, 72 g). The consumption rate was 37.0 g/min, 35.7 g/min and 29.9 g/min for Large White, Landrace and Pietrain. De Haer and De Vries (1993) and Hyun and Ellis (2002) found similar values for consumption rate. An overview on all traits is given in Table 1. These results and the 24 hour profiles for the two dam breeds Large White and Landrace reveal clearly different feed intake strategies: Landrace animals compensate the lower number of visits with a longer occupation time ending up with an even higher feed intake per hour.

Figures 1 to 4 show the 24 hour profiles for the behaviour traits. All two-way interactions were highly significant ($P<0.0001$) for all observed feed intake behaviour traits. The activity pattern with two peaks during a testing day with maxima between 1 p.m. and 5 p.m. was characteristic for all traits investigated apart from the consumption rate which was more or less independent of the hour.

The literature provides examples for both, single peaked (Young and Lawrence, 1994; Hyun et al., 1997) and more often two peaked (De Haer and Merks, 1992; Feddes et al., 1989; Montgomery et al., 1978; Schouten, 1986) activity patterns. In this study light was turned on in the stables automatically at 6 a.m. which might be one explanation for the first activity peak; Feddes, Young and DeShazer (1989) showed the influence of the light period on diurnal activity patterning in pigs.

3.2. Feed intake behaviour during testing period – 112 day profile

The average length of the whole testing period from 30 kg live weight up to 106 or 110 kg differed between the breeds (on average 88 days in Large White, 90 in Landrace and 99 in Pietrain). This has to be taken into account for interpreting the feed intake behaviour during the testing period.

A significant difference between breeds ($P<0.0001$) was detected for all feed intake traits investigated (Table 2). Again, Landrace animals showed the highest time in feeding station per test day (66.09 min) and the highest feed intake per test day (2,349 g) followed by Large White with 62.25 min and 2,293g and Pietrain with 57.36 min and 1,721g. These values are in agreement with observations by De Haer and De Vries (1993), who investigated Belgian Landrace and Great Yorkshire pigs. The amount of feed consumed per day is highly influenced by age and live weight of the

animals. Therefore comparisons with literature are of limited value. Large White showed the highest feed intake per minute (39.4 g/min). Landrace animals have a similar consumption rate (37.5 g/min). Pietrain is clearly slower (31.9 g/min). With regard to the number of visits in the feeding station per day Large White is again the most active breed. Large White animals visited the feeding station 30 percent more often than Landrace animals. The two-way interactions between main effects were significant for all traits investigated with this model ($P<0.0001$).

The feed intake profiles for the testing period (Figure 5) showed a relatively constant number of visits in the feeding station per day during the whole testing period. Only Landrace animals increased the number of visits during the last third of the period. Further, Figure 5 shows the constantly higher activity of Large White pigs compared to Landrace, but due to the longer occupation time in the feeding station of Landrace animals (Figure 6) both dam lines consume a similar amount of feed per testing day (Figure 7). A decrease in the average time per day spent in the feeding station linked with an increase in the daily total amount of feed intake was observed for all breeds. This discrepancy can be explained by the increasing consumption rate (Figure 6-8).

3.3. Effect of the MHS type in Pietrain

For all results above not distinction was made between MHS types in Pietrain. The effect of MHS type on several performance traits is investigated in many studies (e.g. Glodek et al., 2004), but not on feed intake behaviour traits as is this study.

With exception of time spent in the feeding station per day ($P=0.6062$) small but significant differences were detected between stress susceptible and stress resistant Pietrain animals. The average number of visits per testing day was higher in stress susceptible animals (Table 3). The higher consumption rate combined with less time spent in the feeding station per testing resulted in a slightly higher feed intake per day in stress resistant pigs. The two-way interaction between test day and MHS was not significant for any of the traits. Therefore the feed intake profiles were almost identical for the two MHS types (not shown here).

4. Conclusions

Records from the electronic feeding station were in the focus of this study. The behaviour patterns over 24 hours and the testing period of 112 days gave insight in characteristic patterns of feed intake behaviour of pigs housed in group pens. Large

White animals showed clearly the highest activity during a single test day but also over the testing period. However the average time spent in the feeding station per hour and per testing day as well as average feed intake per hour and testing day was highest in Landrace. The feed intake strategy of Large White animals can be characterized by a high number of visits in the feeding station combined with shorter time spent in the feeding station and a lower amount of feed consumed per meal. Landrace animals follow a different strategy: The lower number of visits per hour is compensated with staying longer in the feeding station and higher feed intake per visit. Pietrain animals show the lowest results in all behaviour traits linked to the breed-specific lower feed intake. Whether Landrace and Large White pigs developed different feed intake strategies because they are kept in mixed groups or the same differences would have been observed separating Large White and Landrace groups may not be answered by this study. No additional observation of the behaviour was carried out. Therefore it is not possible to make reliable statements about other important aspects of behaviour like social interaction and competition for feed of animals in mixed groups.

A differentiation between the MHS types in Pietrain is also interesting with regard to the Austrian Pietrain breeding programme, where establishing homozygous stress resistant Pietrain lines is aimed at. The effect of MHS type on feed intake behaviour in Pietrain is low. The small significant differences are of marginal relevance for a practical breeding strategy.

5. Acknowledgements

The authors thank Christian Draxl from the performance test station “Österreichische Schweineprüfanstalt GmbH” for providing data for this study.

6. References

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Feed intake behaviour during testing day – 24 hour profile

Table 1: LS-means for number of visits in the feeding station per hour (NVF-H), time in the feeding station per hour (TF-H), feed intake per hour (FI-H) and consumption rate (CR) in g/min for the breeds Large White (LW), Landrace (LR) and Pietrain (Pit), P-values for the effect breed (P-B) and interaction between hour and breed (P-H*B)

trait	LW	LR	Pit	P-B	P-H*B
NVF-H	1.28	0.88	0.78	<0.0001	<0.0001
TF-H (min)	2.56	2.74	2.37	<0.0001	<0.0001
FI-H (g)	95	98	72	<0.0001	<0.0001
CR (g/min)	37.0	35.7	29.9	<0.0001	<0.0001

Figure 1: 24 hour profile for the trait number of visits in the feeding station per hour (NVF-H)

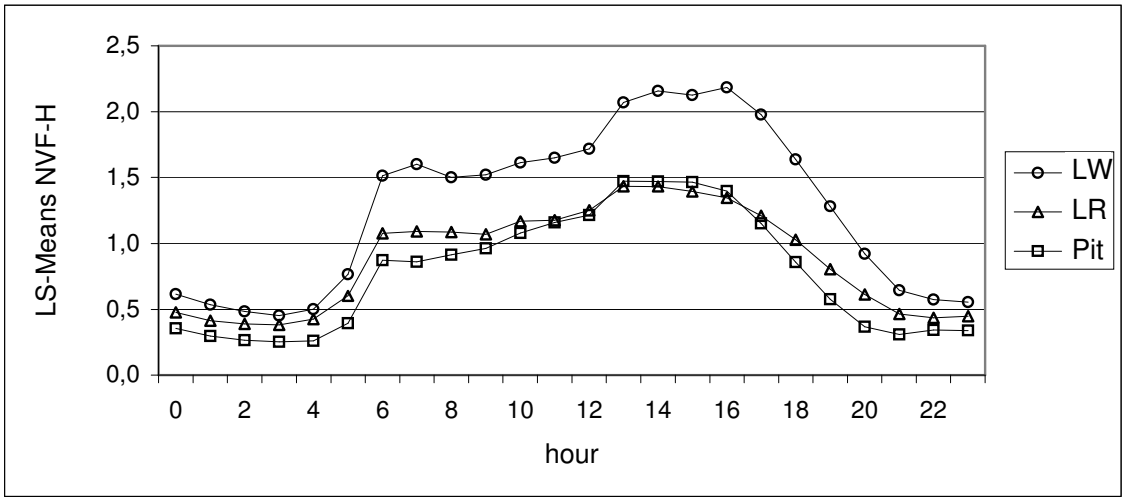


Figure 2: 24 hour profile for the trait time in the feeding station per hour (TF-H)

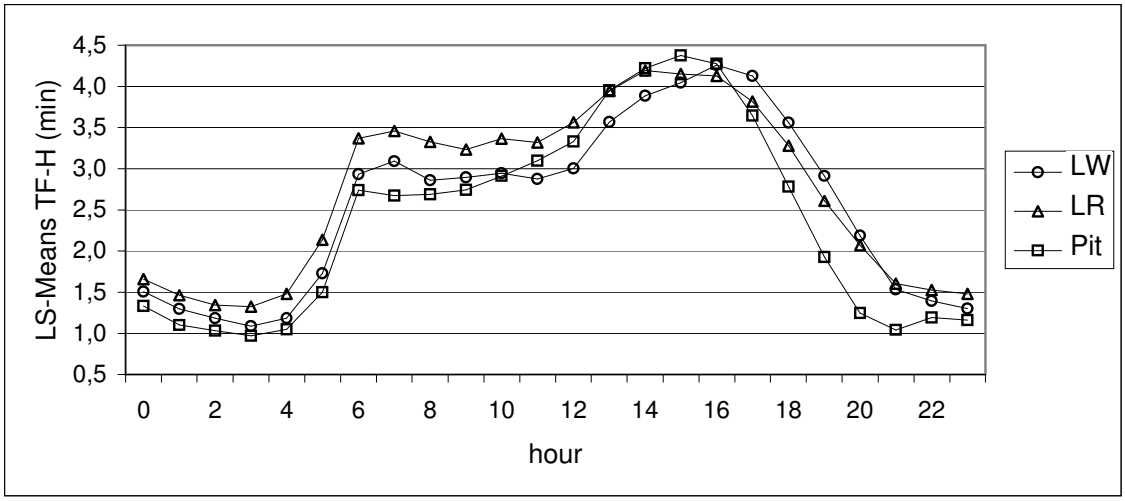


Figure 3: 24 hour profile for the trait feed intake per hour (FI-H)

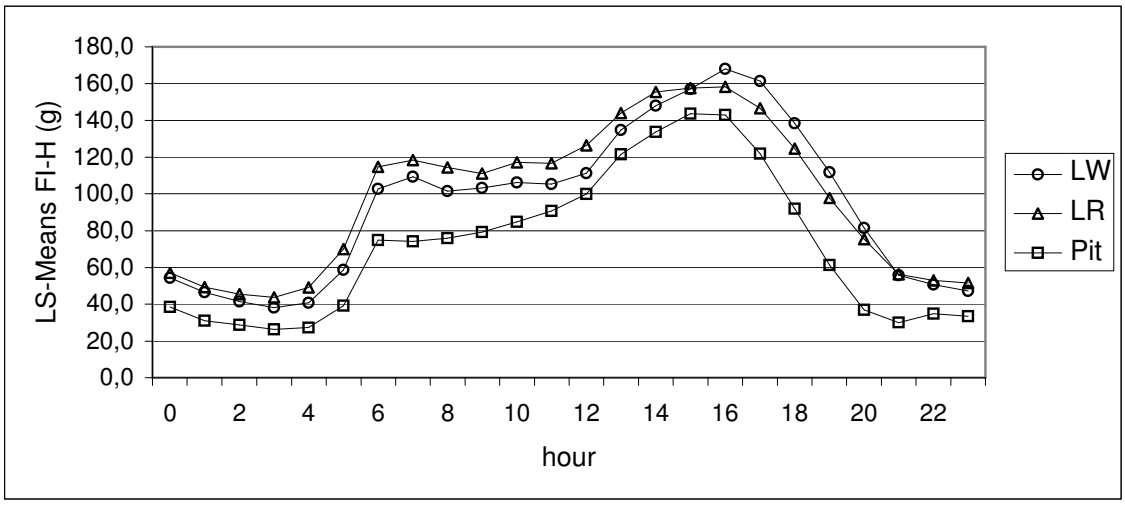
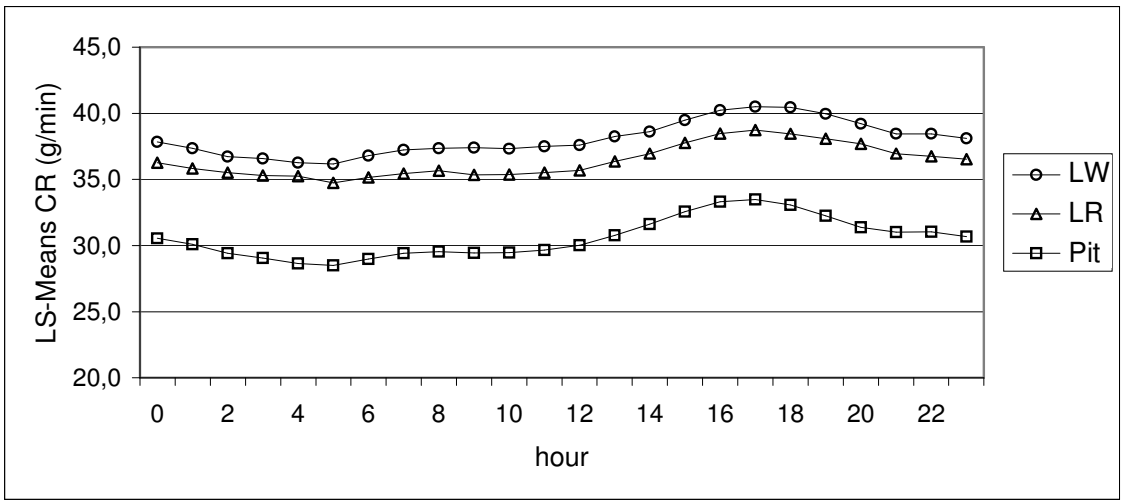


Figure 4: 24 hour profile for the trait consumption rate (CR) in g/min



Feed intake behaviour during testing period – 112 day profile

Table 2: LS-means for number of visits in the feeding station per test day (NVF-TD), time in the feeding station per test day (TF-TD), feed intake per test day (FI-TD) and consumption rate (CR) in g/min for the breeds Large White (LW), Landrace (LR) and Pietrain (Pit), P-values for the effect breed (P-B) and interaction between testing day and breed (P-TD*B)

trait	LW	LR	Pit	P-B	P-TD*B
NVF-TD	31.05	21.04	18.62	<0.0001	<0.0001
TF-TD (min)	62.25	66.09	57.36	<0.0001	<0.0001
FI-TD (g)	2,293	2,349	1,721	<0.0001	<0.0001
CR (g/min)	39.4	37.5	31.9	<0.0001	<0.0001

Figure 5: 112 test day profile for the trait number of visits in the feeding station per test day (NVF-TD)

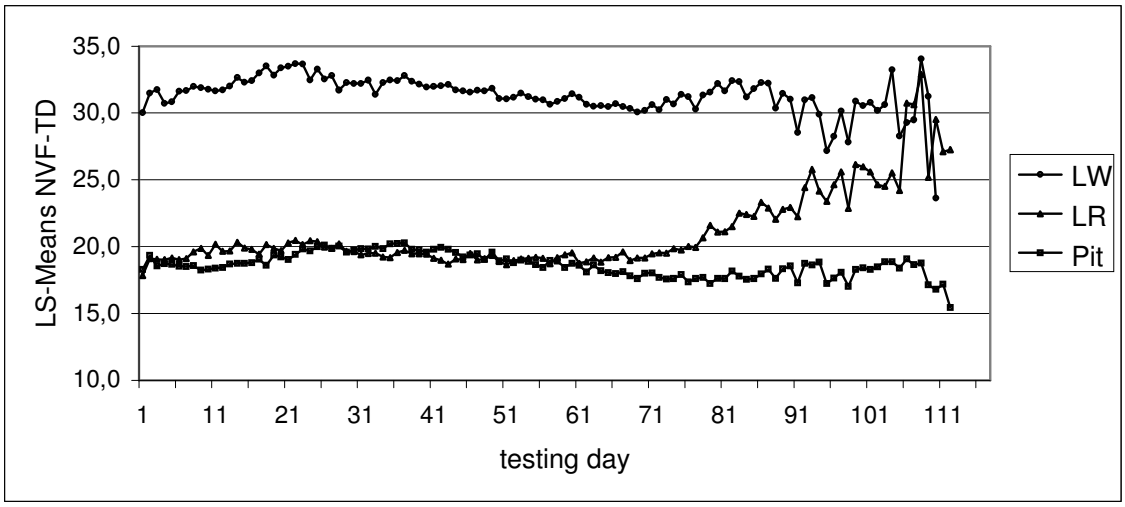


Figure 6: 112 test day profile for the trait time in the feeding station per test day (TF-TD)

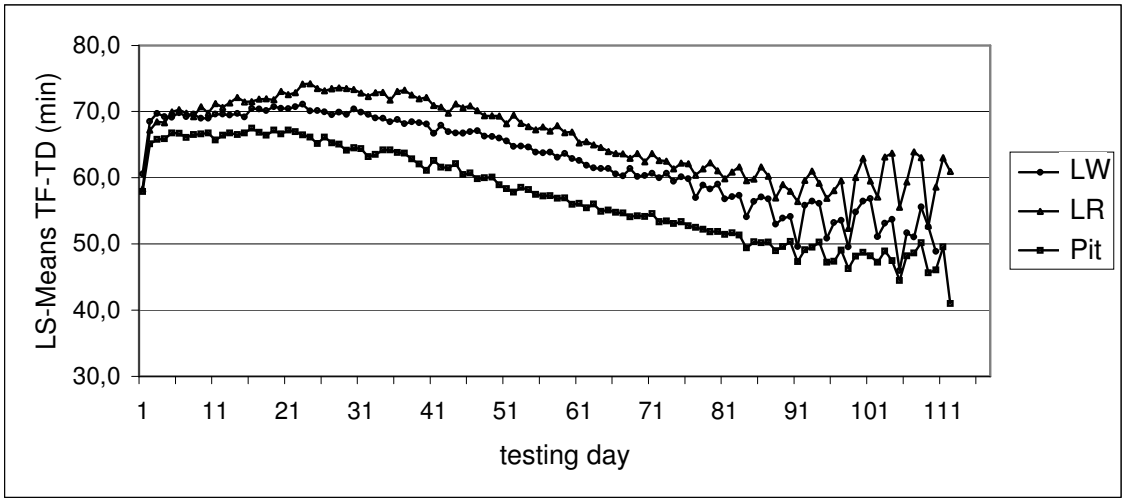


Figure 7: 112 test day profile for the trait feed intake per test day (FI-TD)

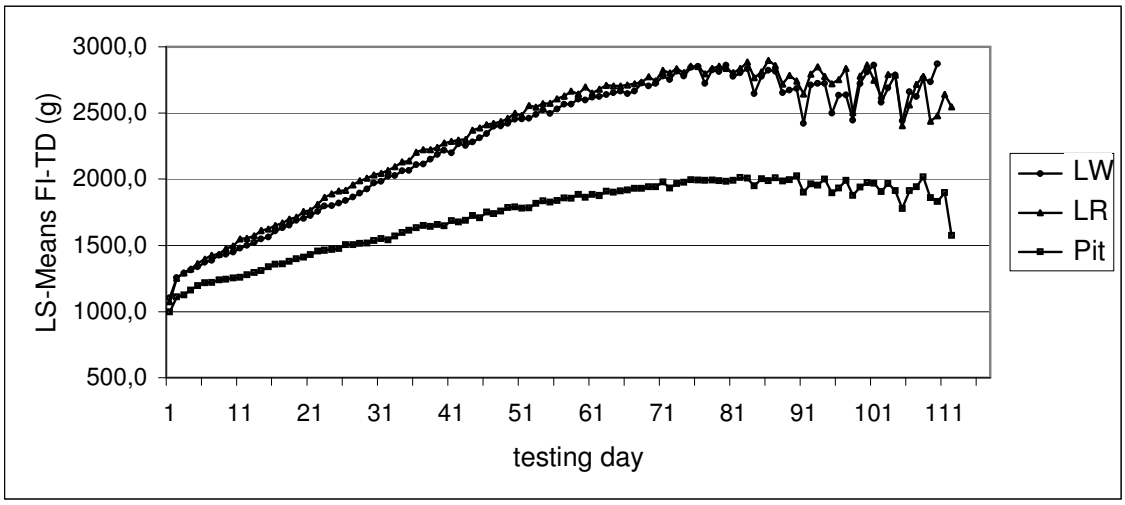
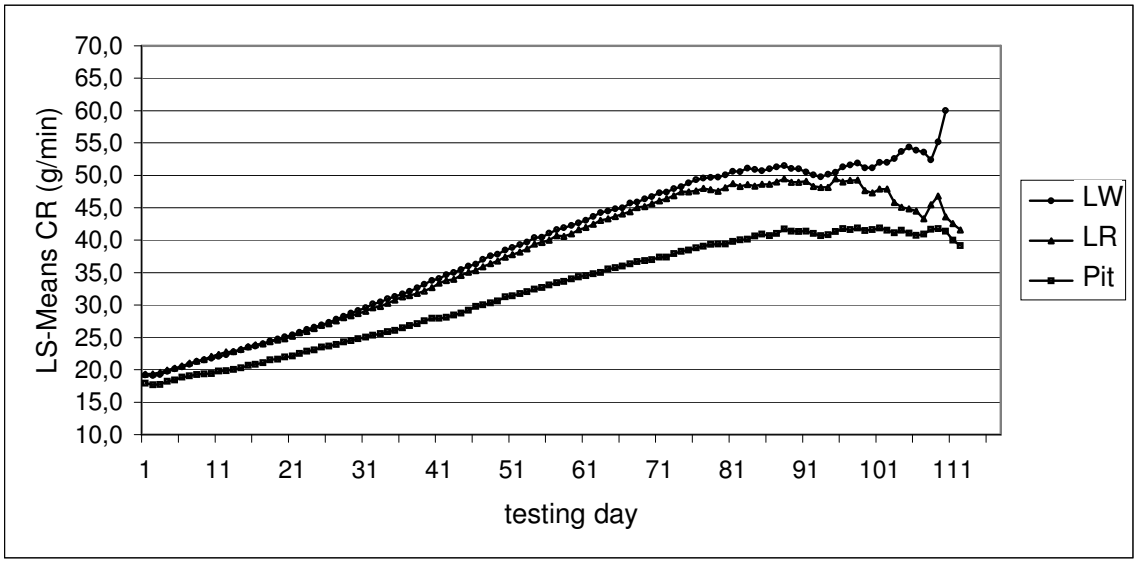


Figure 8: 112 test day profile for the trait consumption rate (CR) in g/min



Effect of MHS type in Pietrain

Table 3: LS-means for number of visits in the feeding station per testing day (NVF-TD), time in the feeding station per test day (TF-TD), feed intake per test day (FI-TD) and consumption rate (CR) in g/min for the MHS types stress susceptible and stress resistant and P-values for the MHS type (P-MHS) and interaction between test day and MHS type (P-TD*MHS)

trait	Stress susceptible	Stress resistant	P-MHS	P-TD*MHS
NVF-TD	19.32	18.04	<0.0001	0.9997
TF-TD (min)	57.53	57.45	0.6062	1.0000
FI-TD (g)	1,710	1,731	<0.0001	0.8310
CR (g/min)	31.7	32.0	<0.0001	1.0000