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GENETIC ANALYSIS OF SOW UDDER TREATMENTS

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SUMMARY

Compromised udder health affects the performance and welfare of the sow and her piglets. Indicator traits for udder health, such as somatic cell count, are difficult to collect and record in sows. In the current study, on-farm udder treatment records were available which were used as an indicator trait for udder health. Genetic parameters were estimated using a threshold model for the udder treatment trait (0 = no udder treatment, 1 = udder treatment). Udder treatments were found to be lowly heritable 0.07 (95% confidence interval between 0.04 and 0.11), and therefore, udder treatment records captured routinely in the herd recording system could potentially be used to genetically improve udder health in sows and reduce sow medication on farms. It was also found that sows who were treated for udder-related conditions weaned half a piglet less per litter compared to sows who were not treated for udder reasons, which equates to $30 AUD / litter and shows the economic importance of improving udder health in sows. Future work could investigate the correlation between udder treatments and other traits, such as sow longevity to further support these findings.

INTRODUCTION

Postpartum disgalactica syndrome (PDS) in sows is a multifactorial disease not only affecting udder health but the reproductive tract, which in turn compromises the performance and welfare of the sow and her piglets (Kemper 2020). PDS is characterised by reduced milk production in the first days after farrowing, leading to increased piglet mortality and lower weaning number (Kemper 2020). One of the factors causing PDS are bacteria, however, to enable ubiquitous bacteria to cause PDS requires non-infectious risk factors to be present, such as prolonged farrowing duration, constipation and high ambient temperature (Kemper 2020). Indicator traits for udder health, such as somatic cell count and milk pH, are limited in sows due to the difficulties in collecting adequate milk (Kemper 2020), making the ability to study udder and milk traits difficult. As an alternative, routinely recorded treatments for udder-related conditions could be used. The aim of this study was to investigate the use of routinely recorded on-farm udder treatments as an indicator trait for udder health and its association with litter survival. It is hypothesised that the trait defined as on-farm recorded udder treatment is heritable and can be used to genetically improve udder health in sows.

MATERIALS AND METHODS

Data. The trait investigated was any medication related to an udder treatment (UT) that sows received during lactation, recorded by staff in the herd recording management system (UT: 0 = no udder treatment, 1 = yes udder treatment). Sows, which required UT treatment were treated with anti-inflammatory drugs, and / or antibiotics. UT is one of multiple treatment reasons recorded on the herd recording management system, with UT having the most frequent reason for sow

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medication on this farm. The data from one maternal line (Landrace, LD) and one maternal crossbred line (LD × Large White (LW)) were collected from a single farm in southern New South Wales, Australia. Data included 7,518 records from 4,347 sows (daughters of 309 sires) collected between November 2023 and October 2024. Records for UT were not censored by other potential concurrent treatments. Fostering of piglets was generally conducted on the first day of the piglets' life to ensure that all piglets had access to a functional teat and colostrum. Sows were treated for udder-related conditions when staff observed that milk production was reduced (with or without mastitis), and piglets' vitality, weight gain and health appeared compromised. Veterinary diagnosis of udder treatments was not performed, but authorisation for treatment was obtained.

Statistical analysis. Parameter estimates for UT were obtained using an animal threshold model via the Bayesian approach with Gibbs sampling as outlined below:

$$\lambda_i = \boldsymbol{X}\beta + \boldsymbol{Z}a_i + \boldsymbol{Z}pe_i + e_i$$

where λ_i was a vector of the threshold liability value for UT (0 = no udder treatment, 1 = yes udder treatment). $\boldsymbol{X}$ is an incidence matrix for the significant fixed effect (β) included parity group (4 levels: parity 1; parity 2; parity 3 and parity 4, > parity 4) and farrowing year month contemporary group (CG: 11 levels). Preliminary analysis found that line, age at first farrowing, and the number of still-born piglets were not significant (p-value > 0.05) for UT, resulting in their exclusion from the operational model. $\boldsymbol{Z}$ represents incidence matrices linking records to random effects, which included the additive genetic effect (a) and the permanent environmental effect (pe) of the sow, accounting for repeated records per sow

The model was implemented using the gibbsf90 + software from the blupf90 suite (Misztal *et al.* 2002). The Gibbs sampler comprised a chain of 100, 000 cycles, with a burn-in of the first 10, 000 iterations and samples stored every 10 cycles. Hence, the posterior means of genetic parameters were estimated from 9, 000 samples. Convergence was evaluated through visual inspection of the trace plot and the Geweke diagnostic (Misztal *et al.* 2002).

The associations between UT, weaning number (WN) and litter survival (LS) after day 1 of age were evaluated. Day 1 litter size was calculated to account for fostering movements and deaths that had occurred very early in lactation, which were not related to the UT trait. LS was estimated as the ratio between the number of piglets alive at weaning and day 1 litter size.

LS was not normally distributed and, therefore, log transformed. LS and WN were analysed using a linear mixed model including parity group, line (2 levels: LD; LD × LW), CG, the permanent environment effect of the sow and UT to characterise the impact of UT on these traits. Further, WN was adjusted for Day 1 Litter Size as a linear covariate. The predicted least square mean for WN or back-log transformed LS were weighted proportional to the frequency of other model factors that were averaged, using R package *emmeans* (Lenth and Lenth 2018).

RESULTS AND DISCUSSION

Phenotypic observations. The prevalence of udder treatment in this study (17%; Table 1), were very similar to those reported in literature (13%; Kemper 2020), with PDS the main reason for udder treatments as described by farm staff. Most udder treatment medications (93%) occurred within the first 7 days after farrowing, as expected (Kemper 2020). Udder treatment was the most frequent reason for treating sows generally and the main reason for administering antibiotics (~50% of the total antibiotic treatment in sows). These results show the importance of improving udder health to also reduce the usage of antibiotics in sows.

In contrast to the current study, Preissler *et al.* (2011) defined the cases of PDS in sows when they showed a rectal temperature above 39.5°C and / or had clinical signs of mastitis. The current study's broad definition of udder treatment can be seen as a limitation from a veterinary perspective. However, diagnosing PDS can be difficult due to the high variation in clinical expression. Consequently, it has been suggested that both the mammary gland appearance and behaviour change in piglets (e.g., weakness) and sows (e.g., limiting access for piglets to teats by lying on the udder) should be used to identify PDS in sows (Kemper 2020).

Further, this study found that the prevalence of UT was highest in parity one sows compared to sows in older parities (23%; Table 1). The reported results of the parity effect on the prevalence of PDS in the literature were inconsistent (Kemper 2020). However, UT treatment in parity one seems not to have a negative effect on staying in the herd until parity two on this farm (P = 0.54).

Table 1. Descriptive statistics of the sow udder treatment trait (UT: 0 = no udder treatment, 1 = yes udder treatment) across parity groups

Trait (units)	Parity	Number of records	Number of Sows	Prevalence (%)
UT (0/1)	1	1,744		23
	2	1,444		19
	3-4	2,256		13
	>4	2,071		15
	overall	7,518	4,347	17

Genetic parameter estimation. The mean heritability of udder treatment was low, h^2: 0.07 (95% confidence interval CI: 0.04 and 0.11; Figure 2). Preissler *et al.* (2012) found slightly higher heritability for PDS (h^2: 0.09), possibly due to a more refined trait definition, as previously mentioned. These results indicate the importance of management strategies to mitigate the incidence of udder treatment. Nevertheless, low heritability for mastitis traits has been found in dairy cattle, and genetic selection for mastitis resistance in the last decade has reduced the incidence of clinical mastitis (Weigel and Shook 2018).

The effect of the permanent environmental effect of the sow was close to zero (pe^2: 0.03; CI: 0.0 and 0.07) using a threshold model, which was also found when fitting a linear model; the permanent environmental effect of the sow was on the boundary to zero. These results indicate that the likelihood of a sow being treated again in subsequent parities is no higher than a sow who has not been treated. This phenomenon seems not to be caused by culling of sows with UT, as UT did not have an effect of parity one sows to stay in herd until parity two, as mentioned above.

Association between UT and LS. Litter survival and weaning number were significantly lower in sows treated for udder-related conditions (Table 2). The difference between litters whose nurse sow was treated for udder-related conditions versus those not treated in weaning number was 0.5 piglets per litter. This equates to $30 AUD / litter and shows the economic importance of improving udder health in sows.

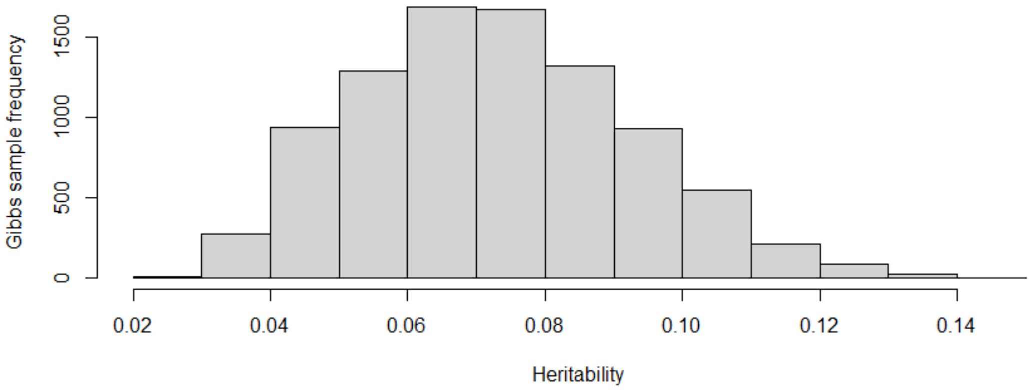

Figure 1. Posterior distribution of heritability for udder treatment in sows

Table 2. Estimated least square means (standard error) for litter survival and weaning number by udder treatment group (0 = no udder treatment, 1 = yes udder treatment)

Traits	**Udder Treatment**		**P value**
	0	1	
Number Sows	3,980	1,193	
Litter Survival (proportion)*	0.90 (0.00)	0.87 (0.00)	<0.001
Wean Number (piglets / litter)	11.5 (0.03)	11.0 (0.07)	<0.001

*Back-log transformed from natural logarithms scale

CONCLUSION

Udder treatment records routinely recorded on farms were lowly heritable ($h^2 = 0.07$) and can potentially be used to genetically improve udder health, even without a veterinary diagnosis. However, the low heritability indicates that the environment (including management) plays an important role in UT. Closer monitoring or revising management practices may be required for sows in parity one. Further, the genetic correlation between UT and other traits, such as litter size and sow longevity, should be evaluated.

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