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Assessment of backfat thickness and its relationship with reproductive performance of sows – preliminary findings

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SUMMARY

Backfat thickness (BFT) is an important trait that influences reproductive performance in sows. This study investigated the relationship between sow BFT at farrowing and the number of live born (LB), stillborn (SB), and Mummies (Ms) in different parities (P) (1, 2, 3, 4, 5, 6, 7 and 8). Backfat thickness was measured at point P2 (BFT at the last rib, at the junction of the thoracic and lumbar vertebrae 3–5 cm from the midline of the spine (mm). In total, 216 sows were measured on day 109 of gestation (when they entered farrowing). Descriptive statistics showed that the mean BFT was 14.55 mm SEM 0.171 SD 2.576. Parity had a significant effect on BFT, with a Kruskal-Wallis chi-squared value of 22.728 (df = 7, p = 0.002). Post-hoc pairwise comparisons using Dunn's test in R revealed that P1 exhibited a significantly higher BFT than P3 (p = 0.001) and P4 (p = 0.025). Spearman's correlation coefficient indicated a very weak negative relationship between BFT and LB, whereas there was a strong relationship between BFT and SB and Ms. However, the correlations were not significant p>0.05. This finding suggests that assessing the BFT before farrowing is a helpful tool for guiding sow management and pig production. Additionally, these findings offer data that can be used to inform culling policies.

Keywords: *Pig production; reproductive indices; commercial herd; Hungary*

INTRODUCTION

Backfat thickness evaluation is regarded as a more objective and accurate method for evaluating pig body condition than visual grading (Charette et al., 1996; Thongkhuy et al., 2019). For instance, a study of various swine production herds in the US and Canada found that sows with an intermediate body condition score of 3 had backfat thicknesses varying from 9 to 28 mm (Authement and Knauer, 2023). The significance of backfat thickness in sows is derived from its correlation with nutritional status, reproductive success, and overall health. Determining the ideal energy reserves needed for successful reproduction and lactation involves determining the ideal backfat thickness (Thiengpimol et al., 2022). Moreover, the heritability of backfat thickness in pigs is high (h2~0.5) (Li and Kennedy, 1994; Davoli et al., 2019). Backfat examining is done to the sows at weaning, 30 days in gestation, and farrowing. This is to monitor the development of body condition throughout the production cycle and ensure that the sows are on a proper feeding curve (Kim et al., 2015; Zhou et al., 2018; Thongkhuy et al., 2020). Numerous factors, including nutrition management (Cole, 2020; Theil et al., 2022), environmental conditions (Thiengpimol et al., 2024; Madeira Pacheco et al., 2024), sperm quality (Barquero et al., 2021), breed (Knecht et al., 2015), and parity (Buthelezi et al., 2024) can affect reproductive success. According to Decaluwė et al. (2013), prolific sows may enhance the number of born alive and future reproductive success by maintaining an ideal body condition and BFT. In their first service, replacement gilts should have back fat depths between 18.0 and 23.0 mm (Thitachot et al., 2021; Roongsitthichai and Olanratmanee, 2021). However, Amdi et al. (2013) found no difference in the overall live born or stillborn among gilts classified as thin or fat at service (19.0 vs. 12.0 mm back-fat depth, respectively).

It is important to know how BFT affects the reproductive traits of a particular breed. Breed has a significant effect on the backfat performance of sows (Bondoc and Isubol, 2020). To maximize output targets and satisfy the goals of modern commercial farms, an evaluation of the physical condition of pigs has emerged as one of the critical variables that must be emphasized. A sow's production is enhanced when she is in optimal body condition and is expected to farrow many piglets, especially in herds with high production levels (Maes et al., 2004). Therefore, to better understand this relationship, we investigated the BFT of Large White × Landrace Hypor genetic sows on a commercial farm in Hungary.

MATERIALS AND METHODS

(I)Study site and herd management

The research was designed as a prospective study conducted by a large-scale pig farm in Hungary. The farm specializes in onsite farrow to finish system of production with Landrace x Large white crossbreeds of Hypor genetics. Sows were artificially inseminated using own farm semen from Duroc terminal sire boars. The boars were Pietrain and Duroc paternal lines meant to produce piglets for fattening. The farm utilizes own stock replacement gilts and upholds a batch farrowing system with approximately 80 sows per week. Pregnant sows from gestation on D109 were sent to the farrowing

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house once per week on Saturday. The herd size was approximately 2600 sows managed in two large farrowing houses and four gestation barns. After farrowing, split suckling, litter equalization, and cross-fostering were performed where necessary. Farrowing was natural; however, sows that had delayed farrowing for up to 1 d were induced using oxytocin injection (0.5 ml). The average total number of piglets born was 17, according to the farm records. On the 3rd day, piglets were injected with iron 30 mg ml^{-1} +133 mg ml^{-1} Forceris (Ceva, Libourne, France), tail docked using electric tail docking, and male piglets castrated. Weaned piglets were transferred from the lactation house to the nursery after weaning. Weaning occurred on D28, which is typically according to the EU Regulations.

Lactation diet was composed of majorly soybean and corn as protein and carbohydrate ingredients respectively (see *Table 1* for detailed ingredient composition) (source: Nutriopt- Trouw Nutrition, Amersfoot, The Netherlands). Sows in lactation were given adlibitum feed upto 8 kgs per day.

Table 1. **Table showing the lactation ingredient composition**

S/no	Ingredient	Value (%)	S/no	Ingredient	Value (%)
1	Soybean 46%	15.500	14	Agrifirm Premium Sow 0.5% uniform premix	0.500
2	Maize flour Agricorn	15.000	15	Sodium Chloride (Salt)	0.500
3	Corn 7%	15.000	16	Benzoic Acid (VEVOVI)	0.500
4	Rye 11%	15.000	17	MonoCalciumPhosphate	0.400
5	Barley 11%	10.000	18	L-Lysine HCL 98%	0.360
6	Wheat bran 15%	10.000	19	L-Threonine 98%	0.150
7	Carrot slice	3.900	20	Arratox toxin binder	0.100
8	Rapeseed meal,Solv.extr. CP 335	3.000	21	DL-Methionine 99%	0.040
9	Sunflower semolina 35%	3.000	22	L-Tryptophan 98%	0.030
10	Soybean husk	3.000	23	Bokasi	0.020
11	Corn oil	1.600	24	Basic	0.015
12	Feed lime	1.365	25	Levucell SB 20	0.010
13	Fatmix (Fish oil)	1.000	26	Enzyme Quantum Blue 5G (S-FM)	0.010
				Total	**100.00**

(II)Data collection and measurements

(i)Backfat thickness measurements

Backfat thickness at P2 point was measured on 220 sows when entering the farrowing house. Backfat thickness at P2 point is described as the BFT at the last rib, at the junction of the thoracic and lumbar vertebrae 3–5 cm from the midline of the spine (mm). Backfat thickness at farrowing was measured at D109 of gestation similar to studies of Kim et al. (2015), Zhou et al. (2018) and Thongkhuy et al. (2020). Evaluation of the BFT was performed using the AnyScan BF device (SongKang GLC LTD, Republic of Korea) with a frequency of 2.5 MHz and a scanning range of 5–50 mm. Before farrowing, four sows that had been measured were found dead (two from unknown causes and two from uterine prolapse); and hence, they were not included in the analysis. Therefore, the final data contained 216 sows that were finally analyzed.

(ii)Reproductive indices

The Selected measures of reproductive performance included

(i) Number of live-born piglets–these are piglets born alive/found alive at the morning cross-check or during the day of farrowing.
(ii) Number of stillborn piglets: These are apparently normal piglets that died shortly before or during the birthing process.
(iii) Number of mummies-these are fetuses that died after ossification and expelled with a characteristic brownish or black color. Record keeping was performed regularly on the sow card and transferred to the computer by the end of the day.

(III) Statistical analysis

Data was entered into SPSS Statistics version 29, and descriptive statistics were performed. Normality was checked using the Shapiro-Wilk test. To assess differences in BFT across parities, the data were analyzed using the Kruskal-Wallis H test, followed by post-hoc pairwise multiple comparisons using Dunn's test in R. The relationships between backfat thickness at farrowing and the number of live born piglets, stillborn piglets, and mummified piglets were analyzed using Spearman's rank correlation coefficient because of the non-normal distribution of data. Statistical significance was set at $p < 0.05$.

RESULTS AND DISCUSSION

(I)Backfat thickness

The mean BFT recorded was 14.55 mm ranging from 10 mm to 22 mm (*Table 2*).

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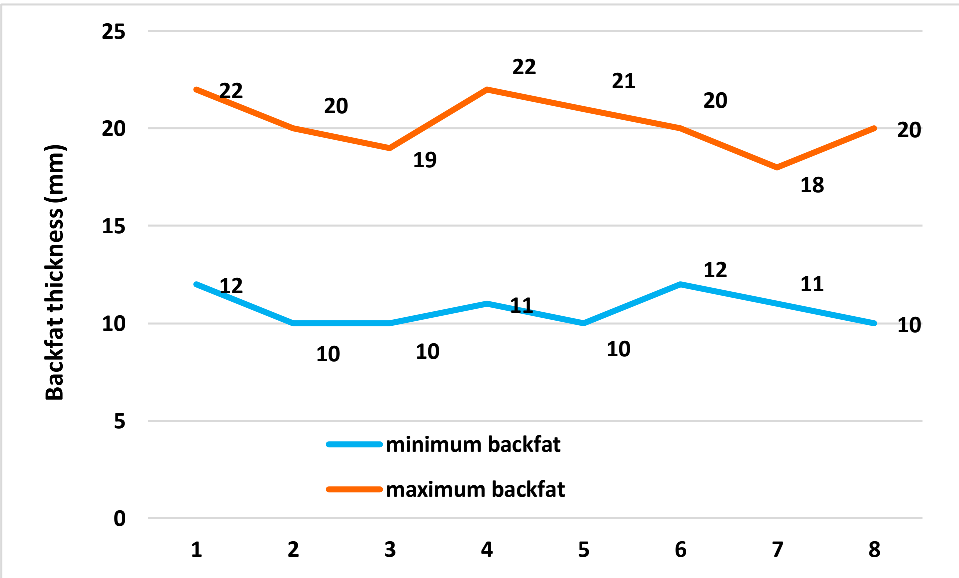
Table 2. **Descriptives of sow backfat thickness per parity D109 gestation (n=216)**

Parity	N	Min (mm)	Max (mm)	Mean (mm)	SD	SEM
1	41	12	22	15.80	2.472	0.386
2	22	10	20	14.73	2.511	0.535
3	47	10	19	13.60	2.061	0.301
4	55	11	22	14.09	2.279	0.307
5	20	10	21	15.35	2.943	0.658
6	13	12	20	15.85	2.931	0.813
7	12	11	18	13.85	1.676	0.465
8	5	10	20	14.00	3.808	1.703
Total	**216**	**10**	**22**	**14.55**	**2.576**	**0.171**

The three main components of subcutaneous or backfat in pigs are lipid, collagen, and water. The concentration of fatty acids in subcutaneous fat is influenced by feed consumption and fat content (Wood et al., 2008). Furthermore, the amount of fatty acids in adipose tissue determines its cohesion and firmness (Wood 1984). The average amount of fat deposition in the sows at the time of farrowing is shown by the mean thickness of 14.55 mm in the backfat (*Table 2*) while the minimum and maximum measurements have been illustrated by *Figure 1*. This measurement provides information on the general health of sows and can be used to evaluate their nutritional status, physical state, and overall health before, during, and after the farrowing process. Determining the average backfat thickness facilitates the evaluation of sows' dietary adequacy. A feeding program is regarded as ideal if the mean thickness falls within the range of 12–16 mm for many breeds (Kim et al., 2015; Zhou et al., 2018). Dietary modifications might be required if it is too high or too low.

Figure 1. **Minimum and maximum backfat measurements across parities**



According to the results, parity 1 sows had an average backfat thickness of 15.80 mm, which was significantly higher $p<0.05$ than that of parity 3 and parity 4 sows $p<0.05$ (*Table 3*). This significant difference implies that parity 1 sows may gain more backfat presumably as a result of higher nutritional needs for growth and fetal development. Gilts are actually feed highly in most commercial piggeries (Leal et al., 2019) to prepare them for lactational demands.

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Table 3. **Dann's test of differences**

Comparison	Z	P value (adjusted)
P1-P2	1.58	1
P1-P3	4.10	**0.001**
P2-P3	1.77	1
P1-P4	3.32	**0.025**
P2-P4	1.06	1
P3-P4	-0.96	1
P1-P5	0.74	1
P2-P5	-0.70	1
P3-P5	-2.53	0.319
P4-P5	-1.86	1
P1-P6	0.84	1
P2-P6	-0.44	1
P3-P6	-1.95	1
P4-P6	-1.36	1
P5-P6	0.18	1
P1-P7	2.32	0.563
P2-P7	0.92	1
P3-P7	-0.44	1
P4-P7	0.18	1
P5-P7	1.51	1
P6-P7	1.21	1
P1-P8	1.74	1
P2-P8	0.82	1
P3-P8	-0.11	1
P4-P8	0.30	1
P5-P8	1.25	1
P6-P8	1.06	1
P7-P8	0.16	1

Significant at p<0.05 level

(II) Reproductive performance

Prolificacy is commonly analyzed to provide performance benchmarks. The total number of piglets born TB includes the number of piglets born alive (BA), stillborn (SB), and mummified fetuses (Ms). *Table 4* shows the correlations between backfat thickness and reproductive performance.

Table 4. **Spearman's Correlations between backfat thickness and prolificacy (n=216)**

Parameters	N sows	Correlation coefficient	P value
Live born	216	-0.094	0.167
Still born	216	0.020	0.772
Mummies	216	0.002	0.977

The number of live born piglets and backfat thickness had a very weak negative correlation, as indicated by the correlation coefficient of -0.094, p = 0.167. This implies that there was no significant relationship between backfat thickness and the number of live born piglets. Similar results were obtained by Maes et al. (2004) and Dizon and Alcantara (2017). These results concur with research suggesting that environmental factors, maternal care, and genetics have a greater impact on live born rates (Lawlor and Lynch, 2007; Chinn et al., 2022). Therefore, in an effort to improve live born outcomes, monitoring backfat is vital, but other factors should also be taken into account. The positive association between backfat thickness and stillborn piglets suggests that too much backfat might cause issues during farrowing, which can affect the sow and the health of the piglets. Sows that are too fat at farrowing experience prolonged farrowing duration with higher risks of stillbirth (Oliviero et al., 2010; Roongsitthichai et al., 2010; Mallmann et al., 2019). This finding highlights the necessity of careful nutritional management to prevent excessive backfat buildup, which may compromise the effectiveness of reproduction. This may entail customizing feeding regimens to maintain ideal body conditions, especially during late gestation. The presence of mummified piglets was strongly correlated with increased back fat thickness, although not significant. This finding implies that higher amounts of backfat may have a deleterious effect on the health or development of the fetus during pregnancy (Zhou et al., 2018; Tian et al., 2019). Since fetuses in larger litters have less uterine capacity to sustain their growth and survival, there is a chance that mummies will increase as litter size increases. (Muirhead and Alexander, 1997).

CONCLUSIONS

This study examined the association of backfat thickness pre-farrowing in Hypor sows. There were notable variations in backfat thickness among sows of different parities, with parity 1 sows showing the highest backfat thickness. These findings indicate that in order to maximize sow health and reproduction, specific dietary and management approaches are required at different stages of parity. As parity increases, the emphasis might move toward maintaining a healthy body condition that promotes continuous productivity without running the risk of productivity-related issues. Parity-based tailored feeding strategies can improve the general performance of herds and the success of reproduction. The study found that, whereas backfat thickness has a weak negative correlation with live born rates, it does have a substantial correlation with mummified and stillborn piglets. The importance of back fat thickness in relation to mummies and stillborns suggests that specific management approaches are required. Producers can enhance their overall herd productivity and reproductive outcomes by focusing on maintaining optimal body conditions.

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Data Availability Statement: None of the data was deposited in an official repository. The data that support the research findings can be obtained from the authors upon reasonable request.

Conflict of Interest: The authors declare no conflict of interest.

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