

Evaluation of reproductive and production traits in the Mangalitsa swine breed

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Abstract. This study evaluated reproductive and productive performance in the indigenous Mangalitsa swine breed by comparing highly prolific sows with a control group under standardized management conditions. A total of 20 farrowings per group were analyzed. All animals were maintained under identical housing, feeding and environmental conditions to minimize non-genetic variation, ensuring that observed differences were mainly attributable to biological and genetic factors. The traits assessed included litter size at birth, litter weight at birth, litter weight at 21 days and mean weaning weight. Results showed consistent and statistically significant superiority of the prolific group across all parameters. Litter size was higher in the prolific group with a mean of 8.45 piglets compared to 6.35 in the control group. Litter weight at birth was also increased, at the prolific group, while litter weight at 21 days showed a marked improvement, reaching 40.39 kg compared to 29.99 kg in the control group. Mean weaning weight followed the same trend, with 10.83 kg in the prolific group and 9.88 kg in the control group. All differences were statistically significant, with *p*-values below 0.0001. The prolific group additionally exhibited higher variability in some traits, although standard errors remained low, confirming reliable estimates. These results indicate improved reproductive efficiency, enhanced lactational performance and superior early growth in the prolific group. In conclusion, within-breed selection for prolificacy in Mangalitsa sows leads to significant improvements in both reproductive output and piglets growth performances.

Keywords: Mangalitsa, swine, indigenous breed, litter size, reproductive performance

INTRODUCTION

In recent years, swine producers have been confronted with a range of significant challenges, such as disease pressures, increased costs for feed and energy, declining product prices, trade restrictions, animal welfare requirements, and a shortage of labor. These factors have compelled farmers to identify and implement solutions aimed at ensuring the long-term sustainability of their operations (Knox, 2024).

Reproductive efficiency has long been a key focus in both farm management and research within the swine industry. Approximately 30% of culled sows are removed from production due to reproductive problems, with most of these losses occurring at low parities, before sows have produced enough piglets to offset production costs and become profitable (Nonneman and Lents, 2023; Stalder et al., 2003).

Swine performance is determined by the interaction between genetics and environmental conditions (Reproto, 2020). Standard female reproductive traits are biologically complex in nature. For instance, the number of weaned piglets is often considered a simple trait, requiring only the counting of piglets at weaning; however, litter size is the result of a combination of total piglets born, survival at farrowing, and survival up to weaning. Pre-weaning survival is even more complex, being influenced by birth weight, the genetic quality of piglets, uterine quality of the sow, and maternal ability to rear the litter, as well as by factors such as ovulation rate, fertilization success, implantation, prenatal survival, and uterine capacity (Zak et al., 2017).

From a biological perspective, female fertility encompasses not only the sows ability to conceive, but also her capacity to support the litter throughout both prenatal and postnatal stages until weaning. This is reflected in the phenotypic and genetic variation of economically important traits in swine production, such as litter size. Reproductive rate, particularly litter size, represents one of the most important economic traits in swine production. As the number of piglets born increases, the sow is required to produce more milk; however, the amount of milk available per piglet decreases due to increased competition for teats (Bortolozzo et al., 2023).

An increase in the number of weaned piglets per sow contributes to improved profitability of swine production systems, while requiring only minimal additional inputs (Linville et al., 2001).

The average litter size at farrowing is influenced by the number of previous parities, the age and quality of spermatozoa, the number of ovulated oocytes, and maternal environmental factors. Conception rates are strongly affected by the number of natural matings or artificial inseminations performed during a single estrus period.

Anestrus or silent estrus represents one of the major limiting factors for the full utilization of reproductive potential in pigs. Prolonged anestrus periods occur particularly in sows after their first farrowing (Rasbech, 1969).

Litter size is primarily determined by ovulation rate and uterine capacity (Bennett and Leymaster, 1989). Gilts born from sows with higher ovulation rates and improved embryonic survival may inherit genes that favor these traits, potentially leading to increased litter sizes in their own reproductive performance, even though litter size is still strongly influenced by environmental factors (Tummaruk et al., 2001; Tummaruk et al., 2023).

In 2016, Freking et al. demonstrated that selection for increased uterine capacity could result in an estimated gain of 1.6 live piglets at birth. As litter sizes have increased, piglet survival has become an increasingly important objective in genetic selection programs, while teat number has gained importance to meet the higher lactational demands (Leite et al., 2021). Improvement in litter size is achieved through selection for ovulation rate, total number of piglets born, and number of live-born piglets (Kemp et al., 2018).

The Mangalitsa breed originated from the crossbreeding of primitive European pigs with Asian pigs introduced into Europe. Although it was not originally developed in Romania, it is considered a local breed due to its long history of rearing within the territory of the country, dating back to ancient times, approximately since 1803. It is a fat-type breed specialized in lard production and comprises five varieties: blonde, red, black, swallow-belly, and barred. Among these, the blonde variety is the most widespread in the country of origin and shows a higher level of genetic improvement compared to the other varieties. Animals of this breed are of medium size, with a relatively short, broad, and well-developed body in depth. The head is of moderate size, with a relatively long, conical snout, while the ears are short and erect in young animals, becoming larger and slightly drooping in adults. The neck is short, thick, and well-muscled. The body is covered with wavy or curly hair, accompanied by a layer of undercoat that is shed during the warm season. Newborn piglets have smooth hair of gray coloration, marked with longitudinal stripes that disappear after a few weeks as the coat begins to become wavy. It is a semi-precocious breed, recognized for its high-quality meat, which is juicy and well marbled, while the carcasses are particularly suitable for the production of traditional winter sausages. It is highly valued by local consumers both for the taste of the meat and, especially, for the quality of the fat. Sows of this breed have low prolificacy, averaging about 6 piglets per litter, of which approximately 5 are weaned. Their milk production capacity is limited, providing only 20–25 kg of milk per lactation. They reach reproductive age at 11–12 months, while full maturity is achieved at around 4 years. (https://conferinte.stiu.md/sites/default/files/evenimente/Buclet_Suine_web_0.pdf).

MATERIAL AND METHOD

The present study was conducted on the indigenous swine breed Mangalitsa, with animals allocated into two experimental groups according to reproductive performance. The first group consisted of sows characterized by high prolificacy and selected for superior reproductive aptitude, whereas the second group represented the control population, including sows with average reproductive results recorded within the breed. A total of 20 farrowings were analyzed in each group. To eliminate the influence of environmental factors, all animals were maintained under uniform rearing conditions, including identical feeding protocols, housing systems, microclimatic parameters, and general management practices. Consequently, the differences identified between groups could be attributed mainly to intrinsic biological variability.

Several productive and reproductive parameters were investigated throughout the study, including litter size at birth (number of piglets born per farrowing), litter weight at birth (kg), litter weight at 21 days postpartum (kg), and mean weaning weight per piglet at 54 days of age (kg/head). The average weaning weight was calculated by relating the total litter weight to the corresponding number of piglets. All observations and measurements were recorded individually for each sow.

Information regarding litter size and litter weights at birth and at 21 days was obtained directly from on-farm records. Weight determinations were performed using a calibrated electronic scale specifically designed for livestock measurements. In addition, the weaning weight of piglets was established through individual body weight assessment within each experimental group.

The statistical processing of the collected data included descriptive statistical methods and inferential analysis using Student's *t*-test to evaluate the significance of differences between the two groups. All analyses were performed with GraphPad Prism software. The graphical interpretation of the data involved the use of diagrams for litter size evaluation, comparative charts of group means, and box-and-whisker plots to illustrate the distribution and variability of weaning weights between the experimental categories.

RESULTS AND DISCUSSION

Number of total piglets born

An essential indicator for assessing the efficiency and sustainability of swine production systems is reproductive performance, which is primarily reflected by the number of piglets born per litter. The prolific group and the control group showed marked differences, as illustrated by the Figure 1.

Based on the recorded data, the prolific group generally exhibited values ranging between 6 and 11 piglets per litter, with a higher frequency of upper values 8; 11. In contrast, the control group displayed a narrower range, mostly between 5 and 7 piglets, indicating lower variability. This distribution suggests an overall increase in the average litter size within the prolific group. Given that both groups were maintained under identical environmental conditions and received the same feeding regimen, these differences can primarily be attributed to genetic factors.

From a breeding and herd management perspective, such variability can be effectively exploited through the selection of superior genotypes. The enhanced performance observed in the prolific group confirms the selection of highly prolific sows for further genetic evaluation and characterization.

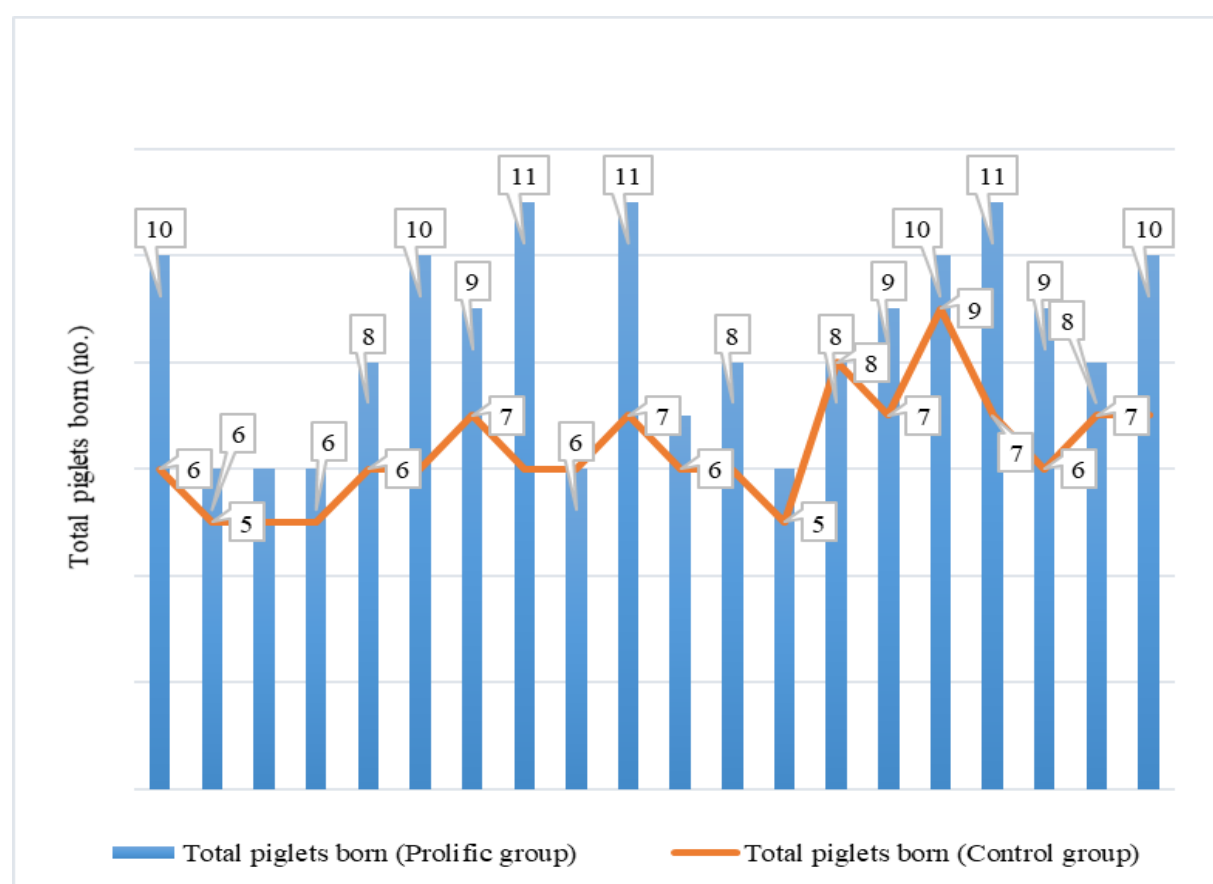


Figure 1. Comparison of the number of piglets born between sow groups

The differences observed between the two groups have a direct impact on productivity and profitability, as a higher number of piglets born per litter contributes to improved conversion efficiency of resources invested in reproduction and growth. An increased litter size also positively influences both the economic and environmental sustainability of production systems by reducing the number of breeding animals required and lowering overall pressure on environmental resources.

The analysis of Figure 2, which compares the two groups, reveals a statistically significant difference in the average number of piglets born per litter, with the prolific group recording higher values. The mean litter size in the control group was 6.35 piglets, whereas the prolific group achieved an average of 8.45 piglets. This represents an improvement of 2.1 piglets per litter, indicating enhanced reproductive performance in the prolific group.

Based on these findings, it can be concluded that further genetic evaluation of the prolific group is justified, as the observed differences highlight their superior reproductive potential and breeding value.

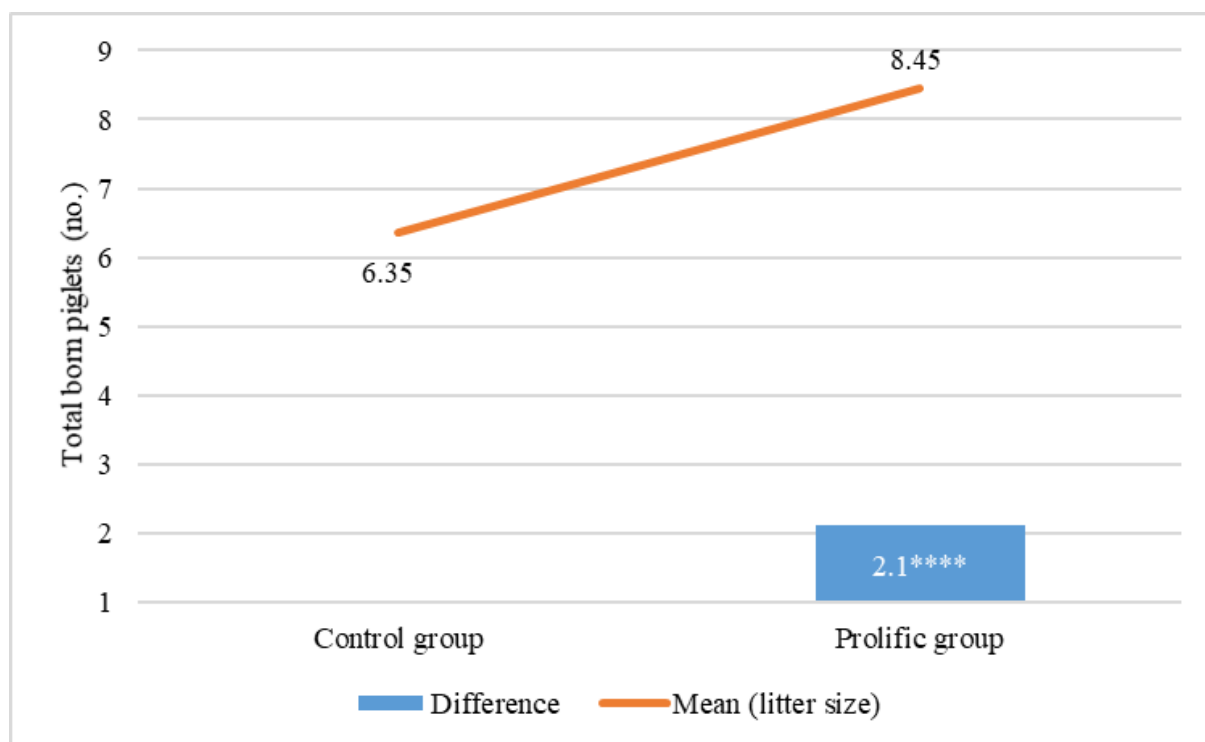


Figure 2. Difference in the mean of number of piglets born within the groups

The mean value 8.45 recorded in the prolific group is considerably higher than that observed in the control group 6.35, indicating an approximate difference of two units in favor of the prolific group. The observed ranges further support this trend, with the prolific group displaying higher minimum and maximum values 6; 11 compared to the control group 5; 9.

Standard deviation is higher in the prolific group 1.82 compared to 1.04, indicating greater variability in responses within this group. However, the relatively low standard error of the mean in both groups suggests a reliable and precise estimation of the average values. Statistical analysis confirmed a highly significant difference between groups, with a p-value below 0.0001 (Table 1).

Overall, the results demonstrate that the prolific group consistently exhibits significantly higher values than the control group, and this difference is strong, consistent, and unlikely to be the result of random variation.

Table 1. Statistical significance assessment between the groups regarding the number of piglets born

Statistical parameter	Control Group	Prolific group
Mean	6.35	8.45
Minimum	5	6
Maximum	9	11
Standard deviation (SD)	1.04	1.82
Standard error of the mean (SEM)	0.23	0.40
P-value	P<0.0001 (****)	

Litter weight at birth

Figure 3 presents the variation of litter weight at farrowing in the control and prolific groups of the Mangalitsa breed across twenty farrowings. The graphical representation shows a clear and consistent difference between the two groups, with the prolific group maintaining higher values throughout the entire observation

period. This pattern indicates superior reproductive performance in terms of total litter weight at birth for the sows included in the prolific group.

The prolific group exhibited higher but more variable values, generally distributed within a wider range, whereas the control group recorded lower values with a narrower dispersion. Although the control group showed greater homogeneity, this occurred at a lower overall level of performance. Such reduced variability combined with lower values may reflect limited productive potential under standard rearing conditions.

Overall, the results highlight a consistent and statistically relevant superiority of the prolific group compared to the control group regarding litter weight at farrowing, confirming improved reproductive efficiency in the selected animals.

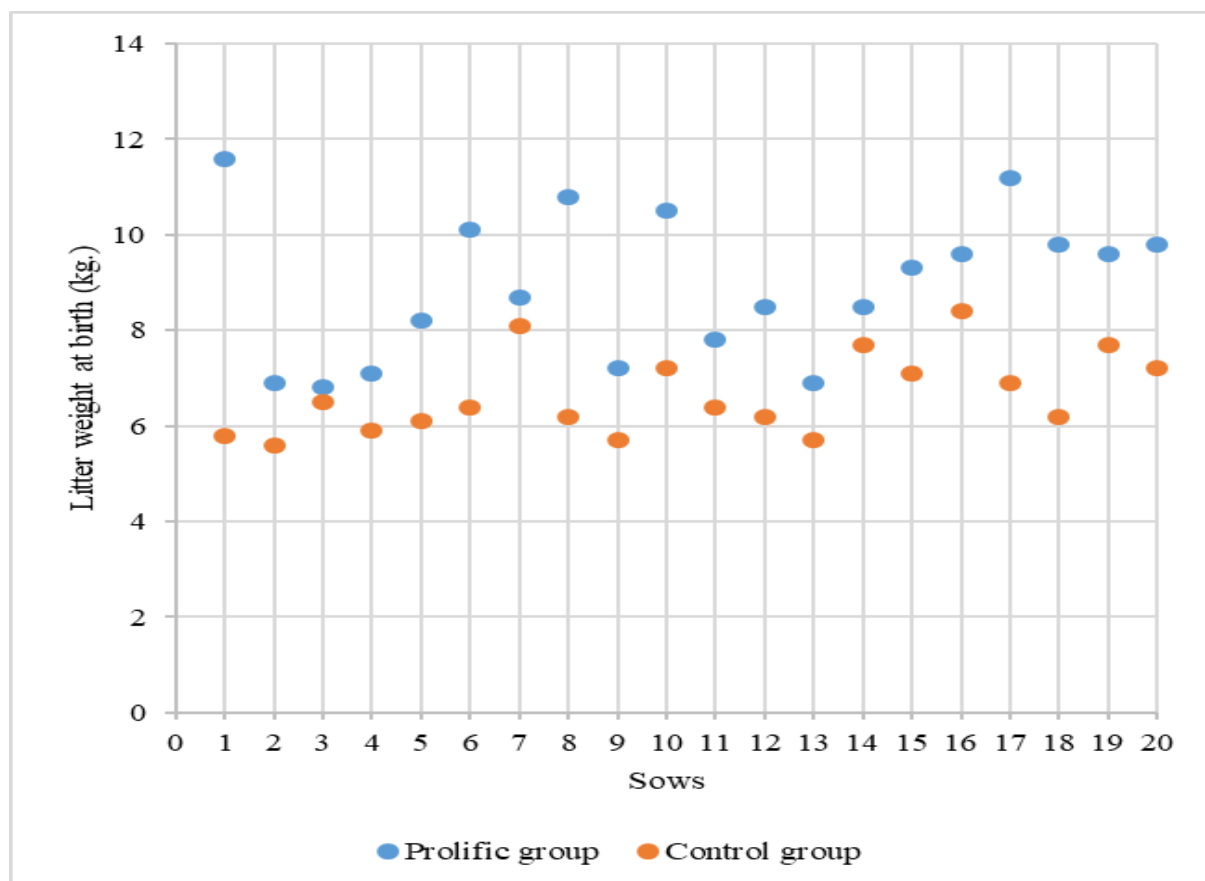


Figure 3. Litter weight at birth in the groups

With regard to average litter weight at farrowing, the differences observed between the control and prolific groups are illustrated in Figure 4. The control group recorded a mean value of litter weight that was lower than that of the prolific group, while the prolific group achieved a higher average, corresponding to an increase of 2.29 kilograms in favor of the selected sows.

In the prolific group, this difference reflects improved embryonic and fetal development, representing a biologically relevant outcome. The higher litter weight at birth suggests that piglets from this group benefited from more favorable intrauterine conditions, resulting in improved uniformity and increased neonatal viability. At the same time, the increase in total litter weight indicates greater physiological efficiency of the sow, associated with enhanced reproductive performance.

The observed difference is not only biologically meaningful but also economically relevant, as higher litter weight at farrowing is positively associated with improved piglet survival rates and better postnatal growth performance.

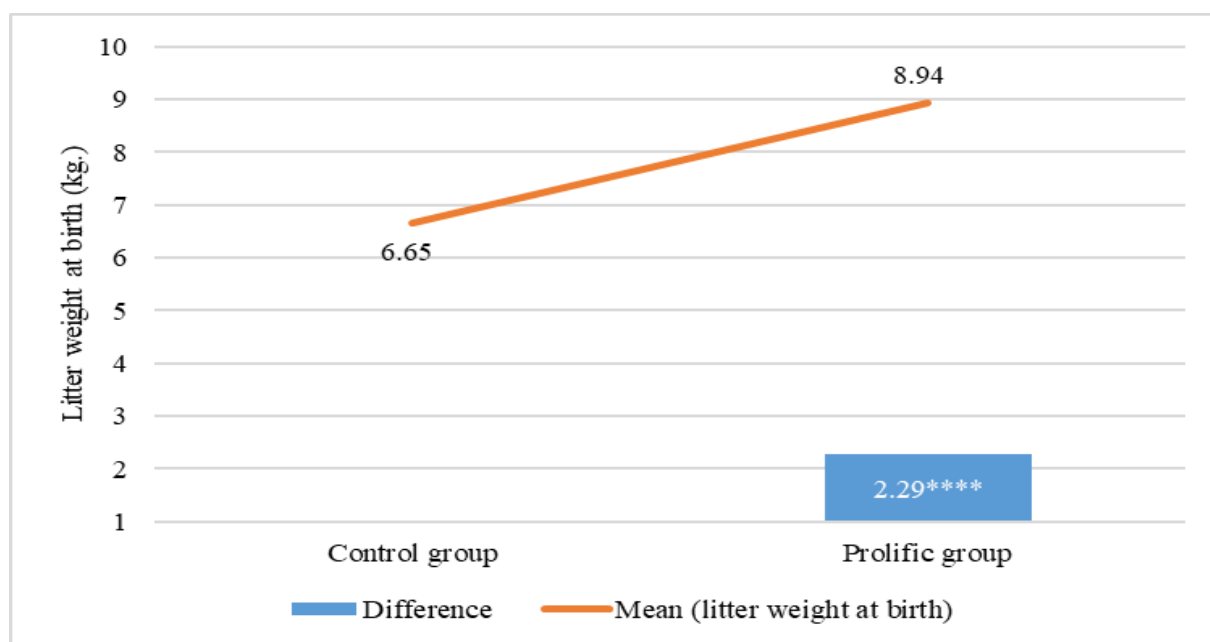


Figure 4. Difference in the mean of litter weight at birth within the groups

As shown in Table 2, the mean value in the prolific group is 8.94, which is considerably higher than that of the control group, recorded at 6.65, indicating a difference of more than two units between the two groups. The minimum and maximum values are also higher in the prolific group, ranging from 6.80 to 11.60, compared to 5.60 to 8.40 in the control group, suggesting an overall superior level of the measured trait. Variability is moderate in both groups; however, the prolific group shows a higher standard deviation of 1.51 compared to 0.84 in the control group, indicating a greater dispersion of data within this group. Nevertheless, the standard errors of the means remain low, suggesting precise estimation of the averages. Statistical analysis reveals a highly significant difference between the two groups, with a p-value lower than 0.0001. In conclusion, the prolific group consistently records significantly higher values than the control group, and the observed difference is robust and highly unlikely to be due to chance.

From a biological perspective, litter weight at farrowing represents a complex indicator of maternal health status, nutritional adequacy, and reproductive efficiency. The increase of this parameter in the prolific group suggests not only improved reproductive output, but also greater uniformity and enhanced neonatal viability, all of which have a direct impact on the economic performance of swine production systems.

Table 2. Statistical significance assessment between the groups regarding the litter weight at birth

Statistical parameter	Control Group	Prolific group
Mean	6.65	8.94
Minimum	5.60	6.80
Maximum	8.40	11.60
Standard deviation (SD)	0.84	1.51
Standard error of the mean (SEM)	0.18	0.33
P-value	P<0.0001 (****)	

Litter weight at 21 days (sow lactation capacity indicator)

Figure 5 illustrates a comparative analysis of litter weight at 21 days of age across twenty farrowings. The presented values indicate a clear and consistent trend of higher growth performance in the prolific group compared to the control group. This difference is observed across all twenty farrowings, suggesting a stable pattern of variation and confirming a more favorable developmental trajectory in the prolific group.

From a visual assessment of the data, litter weight at 21 days in the prolific group generally ranges between approximately 30 and 50 kg, whereas in the control group values are predominantly between 25 and 40 kg. Differences between the two data series are present in all farrowings, with more pronounced gaps observed in certain cases, such as farrowings 5, 10, 15, and 20, where the experimental group values considerably exceed those of the control group. This consistent distribution of higher values in the prolific group indicates a clear advantage in terms of piglet growth rate during the first three weeks of life.

The higher recorded values may be associated with biological or genetic factors that positively influenced growth performance. The graph demonstrates a stable and consistent difference between the two groups, with a more favorable and balanced evolution of litter weights in the prolific group. The absence of abrupt fluctuations or extreme values suggests a high level of uniformity in performance within this group.

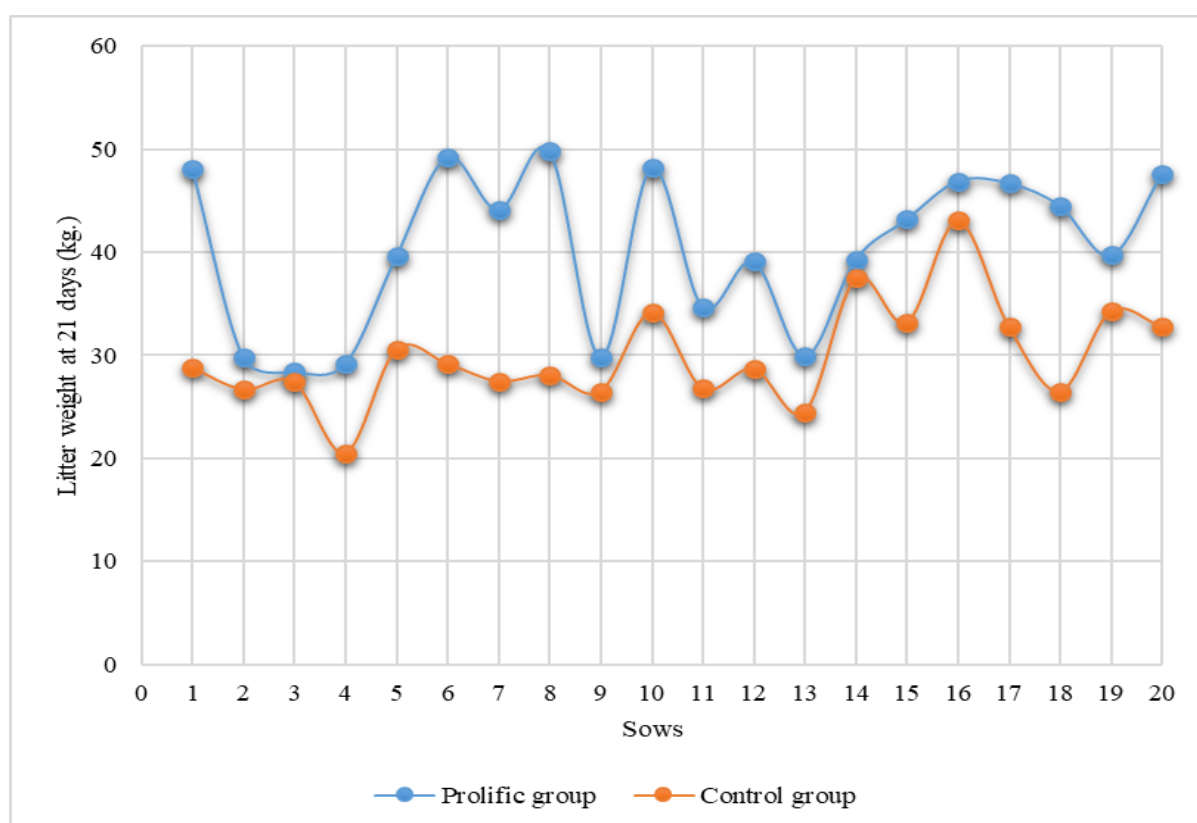


Figure 5. Litter weight at 21 days in the groups

Figure 6 presents a comparative analysis of the mean litter weight at 21 days of age for two groups of piglets. A significant difference is observed between the two groups, with mean values of 29.99 kg in the control group and 40.39 kg in the prolific group, resulting in an absolute difference of 10.41 kg in favor of the latter. This variation highlights superior performance of the piglets in the prolific group during the lactation period.

From a biological interpretation perspective, the difference of more than 10 kg in litter weight at 21 days suggests a more intensive and uniform growth pattern in the prolific group, indicating better early development. This superiority may be attributed to factors such as higher milk production capacity of the sows or greater uniformity of piglets at birth.

The obtained values represent a consistent and practically relevant difference, considering that at this age litter weight is an essential indicator of health status, viability, and future performance potential of young pigs.

In conclusion, the graph clearly demonstrates a markedly superior evolution of the prolific group, showing that under similar management conditions, significant variations in growth performance may occur, likely influenced by physiological or behavioral maternal factors, or by genetic characteristics. The results suggest improved biological efficiency in the prolific group and a favorable outlook for achieving higher productive performance in subsequent growth stages.

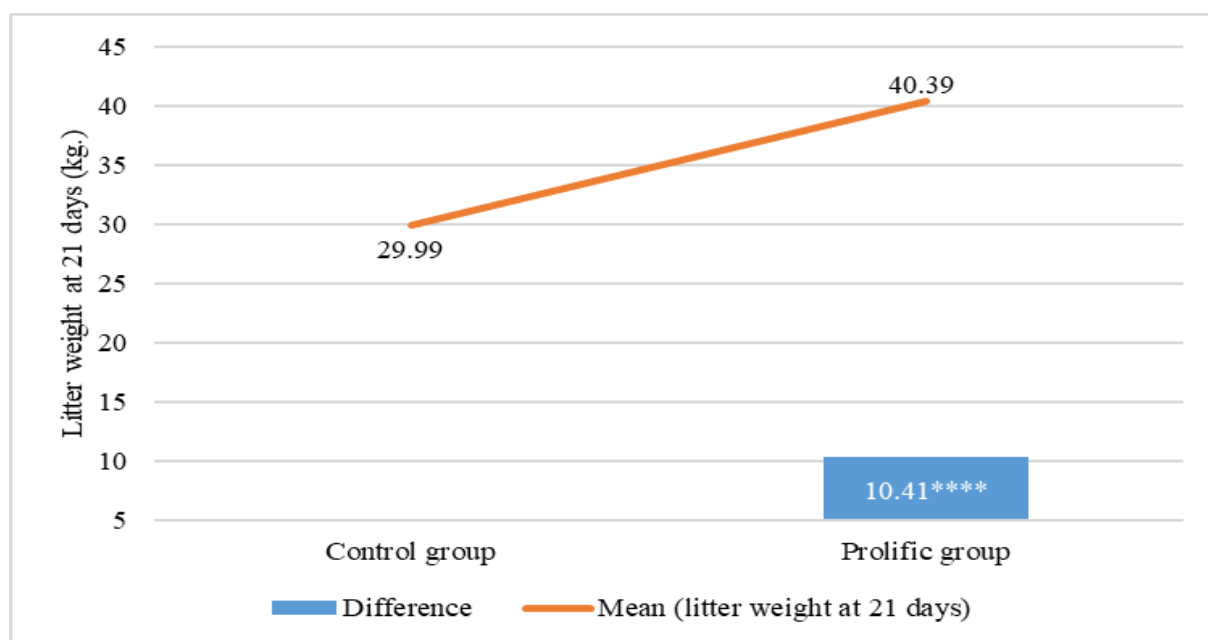


Figure 6. Difference in the mean of litter weight at 21 days within the groups

From Table 3, it can be observed that the mean value of the prolific group 40.39 is considerably higher than that of the control group 29.99. The minimum and maximum values are also higher in the prolific group 28.40; 49.80 compared to the control group 20.50; 43.10, suggesting that the entire range of measured performance values is shifted toward higher levels in the prolific population.

Variability is greater in the prolific group, as indicated by a standard deviation of 7.60 compared to 5.00 in the control group, reflecting a more pronounced dispersion of data. However, the standard errors of the means 1.12 and 1.70 indicate that the estimated averages are sufficiently precise. The observed difference between the two groups is statistically confirmed as highly significant, with a p-value below 0.0001, indicating a very low probability that the results are due to chance. In conclusion, the prolific group shows significantly higher values than the control group, and the effect is robust and strongly supported statistically.

This difference can be explained by several biological and physiological factors. Piglets in the prolific group exhibited a higher growth rate, likely due to increased milk production in sows, better litter uniformity at birth, or more efficient utilization of maternal milk.

From a biological standpoint, litter weight at 21 days represents a relevant indicator for assessing nursing performance and the overall health status of piglets. The higher value recorded in the prolific group indicates not only accelerated growth but also better adaptation to feeding and environmental conditions during the suckling period. This superior performance is expected to ensure a smoother transition to subsequent growth phases, providing a foundation for improved weaning results and later fattening performance.

The obtained results reflect high biological efficiency and enhanced developmental capacity during the early stages of life, confirming the positive impact of the factors that contributed to the performance of this group.

Table 3. Statistical significance assessment between the groups regarding the litter weight at 21 days

Statistical parameter	Control Group	Prolific group
Mean	29.99	40.39
Minimum	20.50	28.40
Maximum	43.10	49.80
Standard deviation (SD)	5.00	7.60
Standard error of the mean (SEM)	1.12	1.70
P-value	P<0.0001 (****)	

Mean weaning weight

The box-plot graph (Figure 7) provides a concise statistical overview of the distribution of average piglet weaning weight in both the prolific and control groups, enabling a comparative assessment of performance.

It can be observed that the prolific group shows a higher mean and median compared to the control group, indicating better body weight performance at weaning. The higher position of the box along the vertical axis reflects that most individual weight values were concentrated at higher levels, suggesting more advanced body development in piglets from this group.

The control group displays a lower median and a slightly greater dispersion, which indicates reduced average performance and a higher degree of variability among individual values.

The comparison between the two groups highlights a clear and consistent advantage in favor of the prolific group. The graphical analysis confirms that the prolific group achieved superior weaning body weight performance, expressed through higher central tendency values and a more compact data distribution.

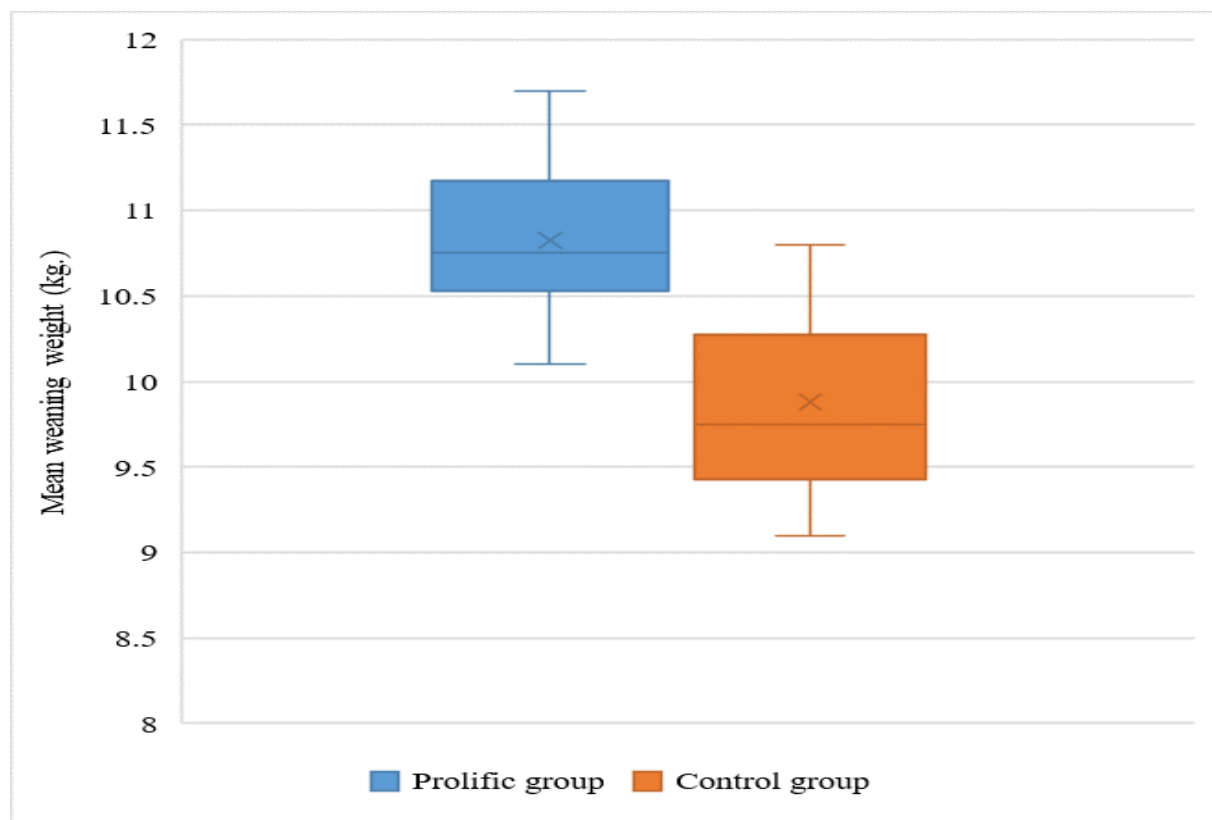


Figure 7. Mean weaning weight in the groups

Figure 8 illustrates the evolution of average weaning weight in the two piglet groups. The mean values indicate a slight difference between the groups, with 9.88 kg recorded in the control group and 10.83 kg in the prolific group, resulting in a difference of 0.94 kg in favor of the latter.

Although this variation is visible in the graphical representation, it cannot be attributed to a specific treatment or intervention, as both groups were maintained under identical housing, feeding, and microclimatic conditions. Therefore, the observed differences are most likely the result of natural biological variation occurring within animal populations, even under standardized rearing environments.

Such variability may be influenced by individual genetic characteristics, the physiological status of the sows, milk production levels, piglet suckling capacity, as well as minor differences in maternal behavior or milk availability during lactation.

Based on the presented values, the prolific group shows a slightly higher performance, which may be interpreted as a positive trend in piglet development within this group. These differences fall within the normal range of biological variability for this age category and the experimental conditions applied.

Overall, the results suggest a generally good health and development status in both groups, with the observed variation primarily driven by individual biological factors and minor differences in maternal performance, rather than any external influence on piglet growth.

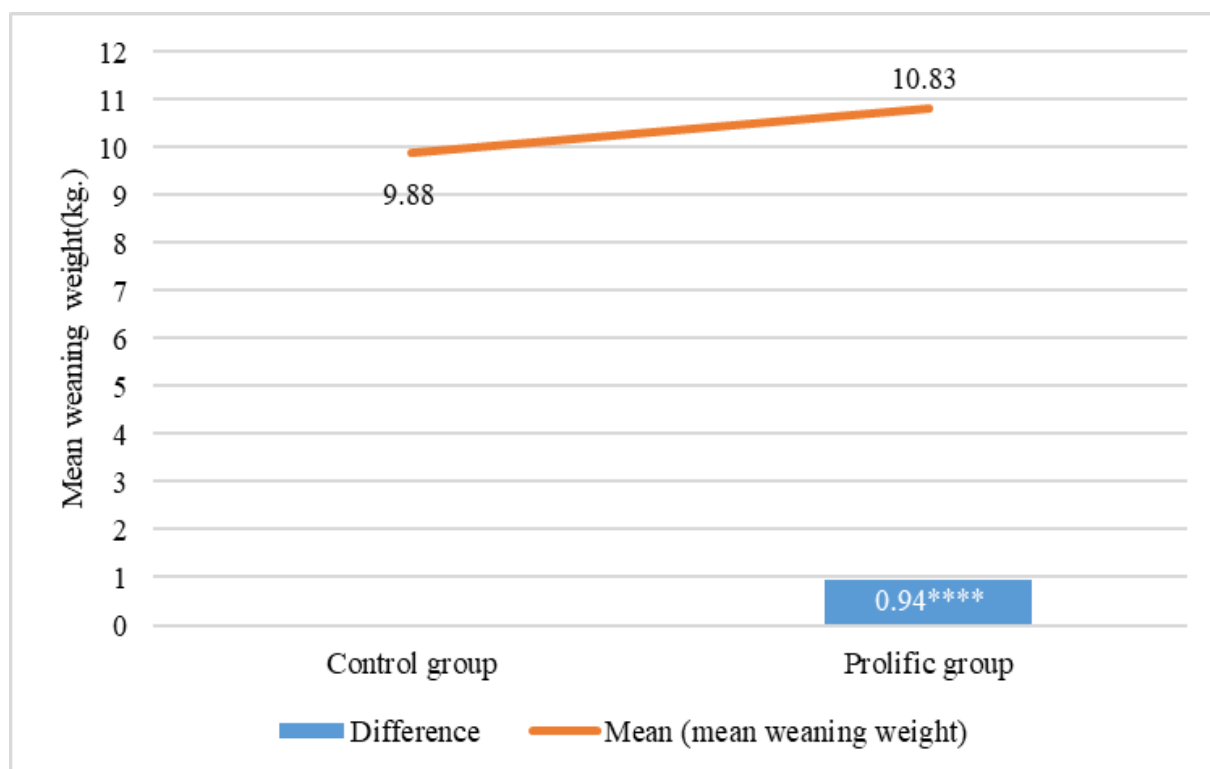


Figure 8. Difference in the mean weaning weight within the groups

The mean value of the prolific group 10.83 is higher than that of the control group 9.88, indicating an approximate difference of one unit in favor of the prolific group. The minimum and maximum values are also slightly higher in the prolific group 10.10; 11.70 compared to the control group 9.10; 10.80, suggesting an overall shift of the distribution toward higher levels.

Variability is low in both groups, and the close standard deviations 0.52 and 0.44 indicate a good level of homogeneity in the data distribution. The standard errors of the means are also small 0.11 and 0.09, reflecting precise estimation of the average values. Statistical testing reveals a highly significant difference between the two groups, with a p-value below 0.0001, indicating that the observed difference is very unlikely to be due to chance, as shown in Table 4. In conclusion, the prolific group presents significantly higher values than the control group, and this effect is clearly and strongly supported statistically.

From a biological perspective, piglets in the prolific group exhibited slightly faster development, maintaining a more consistent growth trajectory up to weaning. This may indicate more efficient utilization of nutrients or a more favorable physiological status of the sows nursing this group. In contrast, the control group, although showing lower average weight, still remained within the normal developmental range for the age and rearing conditions analyzed.

Table 4. Statistical significance assessment between the groups regarding the mean weaning weight

Statistical parameter	Control Group	Prolific group
Mean	9.88	10.83
Minimum	9.10	10.10
Maximum	10.80	11.70
Standard deviation (SD)	0.52	0.44

Standard error of the mean (SEM)	0.11	0.09
P-value	P<0.0001 (***)	

CONCLUSIONS

The comparative assessment of performance between the control and prolific groups consistently demonstrates the superiority of the prolific group across all evaluated reproductive and productive traits.

In terms of litter size, the results reveal clear and statistically significant advantages in favor of the prolific group, which exhibited higher mean values along with lower variability. These differences in prolificacy indicate enhanced genetic potential, coupled with improved reproductive efficiency in the sows belonging to the prolific category.

Litter weight at birth constitutes another key indicator of reproductive success. The prolific group consistently exhibited higher values compared to the control group, indicating more favorable prenatal development and a higher degree of uniformity among newborn piglets. The observed differences are biologically relevant and statistically supported, suggesting that sows in the prolific group provide better conditions for embryonic and fetal growth.

During the postnatal growth period, intergroup differences became increasingly evident. Litter weight at 21 days, an indirect indicator of lactational performance, remained significantly higher in the prolific group. The relatively consistent weights recorded at this stage further indicate improved piglet adaptation and enhanced survival and growth capacity during early development.

Weaning weight per piglet confirmed the same overall pattern. Although the magnitude of differences was lower compared to earlier stages, the values remained statistically significant, reflecting more stable growth dynamics and superior physiological development in piglets originating from the prolific group.

In conclusion, all evaluated traits consistently favor the prolific group, demonstrating significantly improved reproductive and productive performance. These results highlight superior genetic potential, increased reproductive efficiency, and more optimal conditions for early piglet development under standardized management conditions.

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