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Master's Thesis

Effects of lactation length on reproductive performance of sow

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Zásady pro vypracování

Snahou chovatelů prasnic je nalézt nejvhodnější věk pro odstav selat, a to nejen z důvodu welfare prasnic a selat, ale především z hlediska ekonomiky a produktivity chovu.
Krátká doba předchozí laktace je většinou spojena s nižším počtem živě narozených selat, prodlouženým intervalem od odstavu do zapuštění prasnic a nižším procentem oprasení.
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Zaměříte se především na ukazatele jako je interval od odstavu do zapuštění, procento březosti a následnou četnost vrhu, tj. počet všech a živě narozených selat.
V závěru práce vyvodíte zootechnická doporučení pro praxi.

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8 April 2020 Chisenga Emmanuel Mukosha

Abstract

The aim of the master´s thesis was to analyse the effects of the length of lactation between weaning at 21 days (2013–2015) and 28 days (2016-2019) on a commercial farm. The number of total born piglets was higher to the sows that weaned at day 28 (15.0 piglets) by 0.5 piglet compared to day 21. The number of alive born piglets was higher when weaned at day 28 (13.5 piglets) by 1.0 piglet compared at day 21. The average was greater weaning at day 28 (11.5 piglets) showing an increase of 0.7 piglet.

The number of alive born piglets was recorded at its highest in the year 2019 with an average of 14.0 piglets which is an increase of 1.6 piglets ($P < 0.05$) compared to the year 2013 which recorded the lowest average of 12.4 piglets. The highest average was recorded during parity 4 (13.5 piglets) and the lowest during parity 7 (12.2 piglets). The difference was 1.3 piglets ($P < 0.05$). Large White breed (13.2 piglets) had the highest average number of alive born piglets with an increase of (0.8 piglet) compared to the lowest recorded with the Landrace breed (12.4 piglets). The combinations of LW × L (13.1 piglets) had a higher average of piglets of about (0.6 piglet) compared to the combinations of L × LW (12.5 piglets).

The average age at first farrowing was 360.1 days. The correlation coefficients between the age of gilts at the first farrowing and the number of born piglets (total and alive) were evaluated as low and were not statistically significant. A statistical difference in the average number of alive born piglets with sows equal to or less than 114 days had a higher average of about 0.8 piglet ($P < 0.05$) compared to gestation length equal to or more than 115 days. The farrowing interval with ≥ 146 days had a greater average number of alive born piglets by 0.2 piglet in comparison to the average when the farrowing interval was ≤ 145 days. There was an increase in the average to the number of alive born piglets with weaning to conception interval (WCI) ≤ 4 days with an increase of 0.5 piglet ($P < 0.05$) compared to WCI ≥ 5 days.

Key words: sows; reproduction; lactation; weaning; piglets

Abstrakt

Cílem diplomové práce bylo analyzovat vliv délky laktace 21 dní (roky 2013 až 2015) a 28 dní (roky 2016 až 2019) na ukazatele reprodukce prasnic ve vybraném chovu. Při odstavu selat ve 28 dnech byl průměrný počet všech narozených selat (15,0 selat) o 0,5 selete, počet živě narozených selat (13,5 selat) o 1,0 sele a počet odstavených selat (11,5 selat) o 0,7 vyšší než při odstavu ve 21 dnech

Průměrný počet živě narozených selat byl zaznamenán nejvyšší v roce 2019 (14,0 selat). Byl o 1,6 selete ($P < 0,05$) vyšší ve srovnání s rokem 2013, kdy byl zaznamenán nejnižší počet (12,4 selat). Nejvyšší průměrný počet selat byl na 4. vrhu (13,5 selete) a nejnižší byl na 7. vrhu (12,2 selete). Rozdíl byl 1,3 selete ($P < 0,05$). Nejvyšší průměrný počet živě narozených selat měly prasnice plemene large white (13,2 selete). Byl o 0,8 selete vyšší ve srovnání s nejnižším počtem zaznamenaným u prasnic plemene landrase (12,4 selete). Prasnicím LW × L (13,1 selat) se narodilo o 0,6 selete více selat než prasnicím kombinace L × LW (12,5 selat).

Průměrný věk prasniček při prvním porodu byl 360,1 dne. Korelační koeficienty mezi věkem prasniček při prvním porodu a počtem všech a živě narozených selat byly hodnoceny jako nízké, statisticky nevýznamné. Prasnicím s délkou březosti ≤ 114 dní se narodilo o 0,8 selete více ($P < 0,05$) než prasnicím s délkou březosti ≥ 115 dní. Prasnice s délkou mezidobí ≥ 146 dní vykázaly o 0,2 selete vyšší průměrný počet živě narozených selat ve srovnání s prasnicemi, u kterých bylo mezidobí ≤ 115 dní. U prasnic s délkou intervalu od odstavu do zapuštění ≤ 4 dny byl zjištěn vyšší průměrný počet živě narozených selat o 0,5 selat ($P < 0,05$) ve srovnání s prasnicemi, u kterých byl interval od odstavu do říje ≥ 5 dní.

Klíčová slova: prasnice; reprodukce; laktace; odstav; selata

Abbreviations

Ig	immunoglobulin
L	Landrace
LW	Large White
WCI	weaning to conception interval
WSI	weaning to service interval
WMI	weaning-to-first-mating interval
SEW	segregated early weaning
MEW	medicated early weaning
ANOVA	Analysis of Variance

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1. Introduction

In pig breeding it is important to have a realization of the reproductive process on a high quality level and intensity to guarantee constant production of healthy piglets. Excellent reproduction of sows, viability and balance piglets in litter and their readiness to weaning are key factors for effective breeding. From the economic and zoo technical point of view, breeding sows is a demanding category in pig breeding. The aim of sow breeding is to produce viable, healthy and vital piglets. The indicator of the intensity of reproduction and economic efficiency of reproduction is the number of piglets weaned per 1 sow per year.

Reproductive characters are characterized by low heritability which means selection on these characters is difficult, lengthy and effect of selection is low. On the other hand because of low heritability in reproductive characters effect of heterosis is high.

Weaning age is an extremely important management decision in commercial pork production. The decision is based upon many factors which include sow performance, herd health, piglet performance costs and revenues associated with these factors such as lactation space utilization and weaned pig value. Weaning age is generally an outcome determined from the number of sows farrowing each week and lactation space available. During the 1990 (s), lactation length was decreased to improve herd health and reproductive efficiency.

The swine industry has shifted to weaning sows and their litters at earlier ages in order to improve farrowing crate utilization, increase piglets per sow per year and improve piglet health and the operations. Herd performance is normally assessed by the average productivity of the sows or the number of piglets weaned per sow per year.

2. Literature review

2.1 Pig breeds

Maternal breeds

The breeding goal of maternal pig breeds according to (CPBA, 2017) is focused on growth rate (represented by average daily gain measured during field test analysis), reproduction (number of piglets born alive during the second and subsequent parities) and carcass quality (lean meat content).

They are characterized by their excellent reproduction performance (large number of piglets, milkiness, maternal characteristics); excellent growth ability, favourable carcass value (lean meat content); stress resistance; large to larger body frame; solid constitution (https://www.zootechnika.cz/clanky/chov-prasat/plemena-prasat/plemena-prasat---materska-pozice.html).

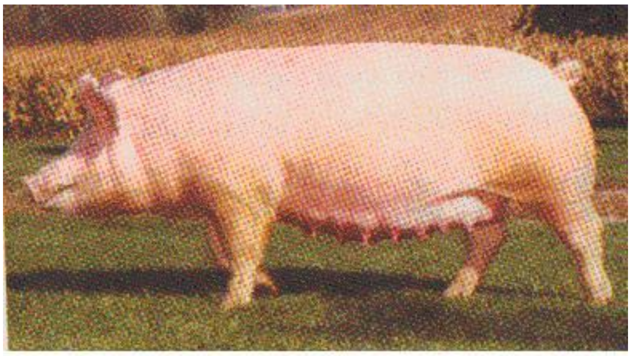
Czech Large White

The Czech Large White is a mix of local Czech pigs, Large White and German Landrace. They have a pink and beige body, though some are white. They have a pronounced snout with erect ears that tend to point forward and a dished face. Their ancestors had low intramuscular fat which affected the taste of their meat, which is why the breed was improved (https://thepigsite.com/breeds/czech-improved-white).

PULKRÁBEK (2005) report that pigs of this breed have very good reproductive traits, excellent growth capacity with very good nutrient conversion, and very good meat performance, while largely maintaining the production type corresponding to the maternal lines.

They have a solid constitution, with good stress tolerance with sows producing very large amounts of milk during the farrowing process (lactation) a necessity in factory farming. Which has led them to becoming a prolific breed in the Czech Republic (https://thepigsite.com/breeds/czech-improved-white).

Figure 1. Czech Large White



Source: STUPKA *et al.* (2009)

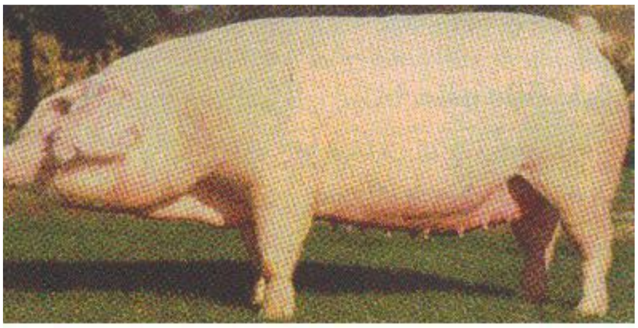
Czech Landrace

According to McGlone and Pond (2003) this breed is known for its sows mothering ability. These pigs have very large floppy ears, are long-bodied, and have the highest weaned average of all breeds, as well as the highest average post-weaning survival rate.

The skin is distorted and firm, the bristles are white, gentle, shiny and close to the body. The claws and dew claws are wax white, the temperament is more vivid (Stupka *et al.*, 2009).

Pigs of Landrace are a universal breed. It is a breed that comes from cross breeding a Celtic pig with Large White. It was cross-bred for the production of bacon. Boars have a live weight of 280–310 kg and sows have a live weight of 240–250 kg (Matoušek *et al.*, 1996).

Figure 2. Czech Landrace



Source: STUPKA *et al.* (2009)

2.2 Reproduction

The reproductive capacity of sows in the herd is one of the most important factors determining the profitability of pig breeding (TUMMARUK and PEARODWONG *et al.*, 2015). According to ČECHOVÁ *et al.* (2015) reproduction is a complex feature that consists of multiple components. The most important component includes the beginning of sexual maturity with the activation of the physiological functions of the reproductive organs, which means the ability of the female genital organs to mate and complete pregnancy, the ability to deliver piglets and their offspring and the reproductive abilities after birth.

The basis of pig reproduction is to obtain the maximum number of weaned piglets per year at as low costs as possible. In addition to genetic improvement of the population and technical modernization of production, nutrition also leads to increased efficiency of pig reproduction (VÝMOLA, 2007).

Reproductive efficiency is usually defined as the number of piglets produced per sow per year. This measure includes two key components – the numbers of piglets produced per litters and the number of litters produced per year (ELIASSON and ISBERG, 2011).

According to (KRUPOVÁ *et al.*, 2016) the number of live-born piglets remains the basic reproduction criterion. The mother´s potential better reflects the total number of piglets born, but the most important economic criterion is the number of piglets surviving.

Reproductive success in pig breeding focuses not only on the number of piglets produced, but also on the quality of piglets. In this case quality includes the health and wellbeing of the piglets, their suitability for their production environment and the extent to which they meet consumer´s expectations of quality (ELIASSON and ISBERG, 2011).

Fertility is a physiological property manifested by the production of larger or smaller litters. Fertility is divided into two types of fertility namely potential and actual. Potential fertility is the ability of a sow to release fertilizable eggs during heat, regardless of their further development. During one heat 14–20, resp. up to 25 eggs, i.e. 120–150% of normal litter size (PULKRÁBEK *et al.*, 2005). Actual fertility is characterized by the number of live piglets born. It is lower than the potential fertility by losses caused by imperfect fertilization of released eggs, embryonic losses, fetal death during pregnancy and during labour (PULKRÁBEK *et al.*, 2005).

2.2.1 Sow reproduction cycle

The gilts which start the reproductive cycle earlier shorten the unproductive period which has a positive effect on the economy of production. However, their physiological and somatic state of development may be insufficient to the birth and rearing of numerous offspring not only in the first litter (SCHUKKEN *et al.*, 1994; SZULC *et al.*, 2009; SZOSTAK and PRZYKAZA, 2010).

Sows and gilts are non-seasonal and polyestrous, with the estrus cycle lasting 18–24 (average 21) days. Sows are behaviourally anestrous during pregnancy. Estrus is characterized by behavioural (e.g., mounting, fence walking, vocalizing, tilted ears, kyphosis) and sometimes physical (e.g., vulvar swelling, vaginal discharge) changes. Estrus lasts ~36–48 hours in gilts and ≥48–72 hours in sows (ALTHOUSE, 2005).

https://www.msdvetmanual.com/management-and-nutrition/management-of-reproduction-pigs/breeding-management-in-pigs).

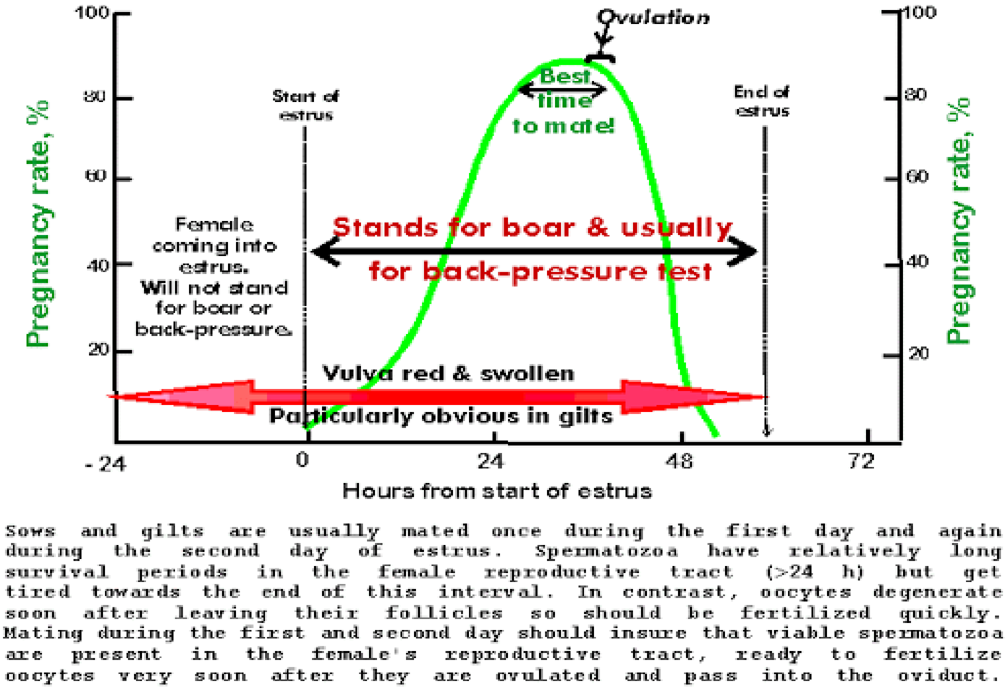
According to (ALTHOUSE, 2005) the time to estrus after weaning and duration of estrus in sows can be influenced by length of lactation, nutrition, body condition, genetics, and other management practices (https://www.msdvetmanual.com/management-and-nutrition/management-of-reproduction-pigs/breeding-management-in-pigs).

Ovulation is defined as the release of oocytes and normally (i.e. in 70% of the cases) occurs within the time of estrus (GILL, 2007). Ovulation start normally occurs from 42 to 44 hours after the beginning of estrus (BELSTRA *et al.,* 2004; KNOX, 2005b) which means during the first part of the last third of the standing heat (GILL, 2007).

According to VÁCLAVKOVÁ (2010), the reproductive performance of sows depends on three main factors. The first is the relationship between the number of ovulated follicles and the number of fertilized eggs, the second is the proportion of viable embryos and fetuses and the third is the morphological and functional characteristics of the uterus allowing fetal development during pregnancy.

Figure 3 shows the changes during the estrus period in sows.

Figure 3. Timing and number of services



Source: http://animalbiosciences.uoguelph.ca/~gking/Ag_2350/pigrepro.htm

2.2.2 Number of total piglets born and alive

Piglet loss before and during farrowing is estimated to be 3 to 10%, post birth mortality is reported to be between 8 and 15%, according to various sources. The highest losses are in the first 2–3 days and represent about 50% of the losses during lactation (MARCHANT, 2000)

According to MALÁŠEK (2015) the main reasons of the loss in the first 3 days are due to lying down, hypothermia and low vitality, and in the following days, the consequences of low intake of colostrum and milk – starvation and infectious factors.

2.2.3 Factors affecting reproduction

Post weaning reproductive performance influences herd productivity on commercial farms (DIAL, 1992). Parity, season, lactation length and lactation nutrition are widely recognized as common factors affecting several of the most frequently used measures of reproductive performance (DIAL, 1992). For instance, lower parity females, especially primiparous sows, have longer weaning-to-first-service and weaning to conception intervals (BRIT, 1992) lighter litter weaning weights and smaller subsequent litter sizes (CLARK and LEMAN, 1986).

2.2.4 Age of the first farrowing

The age of the first farrowing depends primarily on the effectiveness of the first mating. Most of the breeders use gilt mating in the second spontaneous estrus, thus providing the optimal period for the physical and hormonal development of the gilts while starting the reproduction. Every inefficient mating prolongs the age of farrowing of gilts. This may be due to insufficient manifestation of the estrus symptoms or the lack of the standing reflex (STERNING *et al*., 1998; TUMMARUK *et al*., 2007; MATYSIAK *et al*., 2010).

To achieve a higher number of piglets, the gilts must be embedded within 9 months at the latest. It is considered inappropriate to germinate gilts below 220 days and above 280 days (KERNEROVÁ *et al*., 2012). JEDLIČKA (2014) recommends 240 to 250 days as the optimal time for the first conception at 140–150 kg and after the 2nd to 3rd heat detected.

2.2.5 Weaning lengths

Weaning is a stressful experience for young piglets, affecting them both socially and physiologically (ROESE and TAYLOR, 2006). Weaning is usually undertaken in one of the three following categories: *conventional weaning*: 3–5 weeks of age, *early weaning*: 10 days of age to 3 weeks, *specialised weaning*: segregated early weaning (SEW) and medicated early weaning (MEW) (ROESE and TAYLOR, 2006).

Weaning age recommendation is system which depends on the farm management. The right age is anywhere from 18 to 28 days, depending on the objectives of production system. What is absolutely certain is that weaned pigs younger than 18 days of age and lighter than (5 kg) will require extra care, better environment, and better nutrition after the weaning. Piglets weaning at less than (3.6 kg) will barely make it to a full-value pig (ANDERSON, 1993).

Weaning older and heavier piglets also impacts piglet performance after weaning. Heavier piglets at weaning have higher average daily gains, lower mortality rates, and lower production costs in the nursery and finisher phases of production (ANDERSON, 1993).

Many factors have a direct effect on the number of pigs weaned per sow per year in a farm, among them gestation length, lactation length or weaning age, and weaning to service interval (WSI). To increase the number of pigs per sow per year is necessary to reduce the lactation length or the WSI. However, lactation length and WSI may affect the next litter size (ANDERSON, 1993). However, increasing lactation length would increase farrowing interval, decrease pig weaned per farrowing per year and could reduce breeding herd productivity (KING *et al*., 1998).

2.2.6 Weaning to conception interval

CLARK and LEMAN (1984) found that early weaning of pigs had no effect on next litter size of sows, when the weaning to conception interval was greater than 14 days. However, when weaning to conception interval was less than 14 days, litter size was reduced by 0.1 piglets per day between lactation length of 21 and 28 days.

According to KOKETSU *et al*. (1996) parity 1 had the longest ($P < 0.05$) weaning-to-first-service and weaning to conception intervals. Parities from 2 to 10 had similar weaning-to-first-service and weaning to conception intervals. CLARK and LEMAN (1987) concluded that weaning-to-first-service interval increases by approximately 1 day for each 10 day reduction of lactation length.

2.3 Lactation

Lactation or milk production is a function the sow must perform well to rear the farrowed pigs successfully. The sow’s udder consists of mammary or milk producing tissue and teats that serve as canals to give the pigs access to the milk. Ideally, these teats should be evenly spaced so the milk produced is divided equally among all teats. Front teats, however, are spaced more widely than hind teats. This possibly explains the greater milk production and faster growth of pigs suckling the front teats (DOVE, 2009).

According to (DOVE, 2009) the composition of sow’s milk varies greatly due to the stage of lactation, nutrition and genetics. Colostrum contains a greater concentration of immunoglobulin proteins, increasing the percent of solids and total protein in the milk. As lactation progresses, the fat and lactose (milk sugar) proportions increase and protein decreases.

Table 1. Typical composition of sow's milk (%)

	Colostrum	Normal milk
Total solids	30,0	20,0
Protein	17,0	5,4
Fat	7,5	8,3
Lactose	3,0	5,0
Ash	0,6	0,8

Source: Dove, 2009

The high-producing sow nurses and weans more than 12 piglets (STRATHE *et al.*, 2016, 2017), placing an increased demand on the nutrient availability for milk production. Increasing milk yield and nutrient contents is essential to meet the energy and nutrient demand of the large litters (MANJARIN *et al.*, 2012). Milk production by the mammary glands is influenced by genetics and nutrition (INDIANA, MICHIGAN, AND OHIO SWINE NUTRITION GUIDE, 1998). The high production of milk is subject to high daily gains, the homogeneity of the litter and high live weight of weaned piglets.

Milk yield and composition are directly related to the baby pig survival and growth. Weight of the litter at 21 days (the peak of lactation) is a reliable measure of the sow's milking ability when adjusted for the number of pigs nursed (DOVE, 2009).

Milk production increases after farrowing to the peak in the third to fourth week (ELSLEY, 1971) and body weight changes show a similar trend (ARC, 1981).

2.3.1 Colostrum

The porcine mammary gland starts to produce colostrum before parturition and this production continues until up to 48 hours after the onset of lactation (KLOBASA *et al.*, 1987). Colostrum production has been reported to range from 2.5–5 kg (FARMER *et al.*, 2009). Both colostrum quality and quantity can be modified genetically, hormonally and nutritionally (LOISEL *et al.*, 2014). As the mammary gland continues to produce, colostrum is gradually replaced by mature milk.

This event occurs from around 24 to 36 hours after parturition (ROOKE and BLANDET, 2002).

At birth piglets are exposed to an abrupt change in energy supply as they begin enteral feeding. Additionally, the environment a piglet is born into is generally cold. Heat is rapidly lost from the new-born piglet because of a high surface area to volume ratio and wet skin and so body temperature declines rapidly (THEIL *et al.*, 2014).

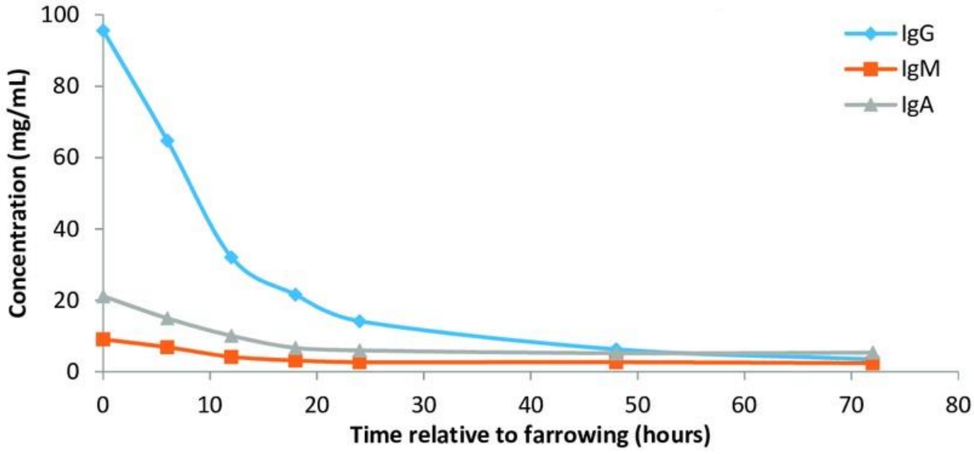
New-born piglets have less than 2% body fat but have high energy requirements and so enter a negative energy balance shortly after birth (THEIL *et al.*, 2014). Colostrum is composed of protein, fat and carbohydrates, all of which are rich energy (LE DIVIDICH, 2005) and help piglets to overcome this negative energy balance. Fat present in colostrum still provides piglets with 40–60% of their total energy supply (LE DIVIDICH, 2005). As a piglet begins to suck and ingest colostrum energy and warmth are provided which act to increase body temperature and viability both being strongly linked to survival.

According to VEJČÍK *et al.* (2001) after farrowing, the sows excrete colostrum which contains more vitamin A, D and C and other protective substances. The main ingredients of the colostrum are proteins (5.5%), fat (7.0%), milk sugar (4.0%) and ash (0.8%).

The sow is unable to transfer antibodies in utero to the piglet via the placenta (BARTOL *et al.*, 2013). Thus, antibody transfer from colostrum is crucial for adequate immune function. Immunoglobulin (Ig) G is the predominant antibody in colostrum and acts to protect the piglet against infections. Colostrum also contains IgA and IgM, leukocytes, selenium and vitamin E, all of which are important for immune function (LE DIVIDICH e*t al*., 2005).

The production and composition of colostrum and milk is essential for the piglets' ability to survive and grow, both during lactation and after weaning (DEVILLERS *et al.*, 2007; KIM and WU, 2009; CABRERA *et al.*, 2010). A high intake of colostrum is an important factor for piglet survival during the first days of the nursing period (ROOKE and BLAND, 2002; FARMER and QUESNEL, 2009; THEIL *et al.*, 2010; QUESNEL, 2011).

Figure 4. Concentration of immunoglobulins in sow colostrum over a 72 h period post farrowing



Source: adapted from KLOBASA *et al*. (1978)

2.3.2 Factors affecting lactation

According to (DOVE, 2009) milk production or yield is affected by udder (teats) shape as well as by nutrition, environmental temperature, genetics, mold toxins, diseases and other factors.

Post weaning reproductive performance influences herd productivity on commercial farms. Parity, season, lactation length, and lactation nutrition are widely recognized as common factors affecting several of the most frequently used measures of reproductive performance (DOVE *et al*., 2009).

2.3.3 Lactation length

Some farms use short lactation length in order to maximize the economic benefits. American farms use lactation length of 21 days or 14 days to get more litters per sow per year (FAHMY 1981); whereas, in Europe, by law, lactation length of 28 days are used, because of improvement of reproductive traits (KOKETSU and DIAL 1997) and welfare reasons; however, this practice may decrease the number of litters per sow per year. Short lactations are associated with a smaller litter size at the subsequent farrowing (XUE *et al.*, 1993; DEWEY *et al.*, 1994; MABRY e*t al.*, 1996). One of the key concerns in the use of early weaning is that reproductive performance may be impaired of sows that lactate for only a short period (KOKETSU and DIAL, 1997b).

Reduction of lactation length has been one of the most prominent features of the evolution of modem swine production. The primary benefit of shorter lactation length is an increased frequency of farrowing, ideally resulting in more pigs produced per sow per year, and more efficient use of farrowing facilities. Attempts to minimize lactation length have led to the recognition of several biological consequences that may offset the gains associated with increased frequency of farrowing (XUE *et al*., 1993).

Shorter lactation length (3 to 4 weeks) improves litters per female per year by reducing farrowing-to-conception intervals; it increases facility utilization by increasing the number of litters farrowed per farrowing space per year. However, shorter lactations also prolong weaning-to- first-service interval and decrease litter size at the subsequent farrowing (XUE *et al*., 1993).

According to (XUE *et al*., 1993) it appears that shorter lactation lengths enable sows to have more litters per year, but these litters may be reduced in size. Also, short lactation length decreases average feed intake during lactation. However, there is another concern that some nurse sows with increased lactation length can lose too much of their body reserves due to high milk yields, and so they may have prolonged WMI and lower farrowing rate (KOKETSU *et al*., 2017). Greater feed intake during lactation may alleviate the negative influence of short lactation on weaning-to-mating interval (KOKETSU and DIAL, 1997b) by stimulating LH release and increasing the concentrations of glucose and insulin in blood.

To increase the number of pigs per sow per year it is necessary to reduce the lactation length or the WSI. However, lactation length and WSI may affect the next litter size. During lactation the sows are in physiological anestrus which is rapidly reverted after weaning (ANDERSON 1993).

2.3.4 Lactation feed intake

It is critical to optimize feed intake in lactating sows. Lower lactation feed intake is associated with lower average weaning weight of piglets, prolonged WMI, low farrowing rate, as well as more returns or more culled sows due to reproductive failure, and also fewer number of alive born piglets at subsequent parity (KOKETSU *et al*., 1996.) Insufficient intake of certain nutrients, especially lysine and energy, or feed during lactation increases weaning-to-first service interval and decreases subsequent litter size (KING,1998).

According to KOKETSU *et al.* (2017) parity 1 sows have low feed intake during lactation is detrimental to post weaning reproductive performance. In addition to the amount of the feed intake, some lactation feed intake patterns (e.g., major dip) are related to prolonged WMI and more culled sows due to reproductive failure. However, current increases in lactation length and the use of advanced automatic feeders for lactating sows may reduce these risks to reproductive performance.

According to KOKETSU (2017) the low reproductive performance of lower parity sows can be explained, in part, by their nutrition. Since the lower parity sows had not reached their mature size and weight, their nutritional requirements were different from those of mature sows. They also consumed less feed than their higher parity counterparts during lactation, which is a critical period for post-weaning reproductive performance (O'GRADY, 1985).

2.4 Gestation

Gestation length is a very constant trait and therefore difficult to manipulate for improvement purposes (ANDERSON, 1993). The average length of the gestation is 114 days, but it can range from 111 to 116 days. Because progesterone is the hormone responsible for maintaining pregnancy, the concentration of progesterone must decline before farrowing can occur (RICHARD, 1997).

According to VANDERHAEGHEN *et al*. (2011) premature labour affects birth weight of piglets, post mortem mortality, composition and intake of colostrum and milk, and growth rate during rearing.

According to STUPKA *et al.* (2009) the length of gestation in young gilts is 0.5–1 days shorter than in older sows. Sows with a gestation length below 112 days showed significantly fewer alive born piglets compared to sows with a gestation length of 114–117 days. Sows pregnant more than 117 days had fewer live born piglets than sows with a gestation length of 114–117 days, the difference being 1.5 piglets ($P < 0.01$) (VANDERHAEGHEN *et al*., 2011).

3. Aim of study

The aim of the master´s thesis was to analyse the reproduction effects on sows during lactation period of 21 and 28 days. The theoretical part was focused on the maternal breeds and the factors that affect reproduction e.g., weaning length as well as lactation and its length. The aim of this thesis was also to analyse the factors that affect reproduction length in relation to lactation length e.g., effects of the year, parity number, genotype, age at first farrowing, gestation, farrowing interval, weaning to conception.

4. Materials and Methodology

4.1 Materials

The selected farm keeps a breeding herd of pure-bred breeding pigs – Large White. The Large White sows from the multiplier herd are mated by Landrace boar. In the production herd are kept hybrid gilts F1 generation – either LW x L or reciprocal combination L x LW and are mated by Duroc boar in order to produce final hybrids for the fattening herd.

Boars were used to help search onset and expression of estrus in sows and gilts. Insemination was the method used for reproduction on all sows. Inseminated sows and gilt were housed individually until pregnancy was detected. Detection of pregnancy was performed around 30–35 days after insemination. The pens were arranged in 2 rows. Between the rows of pens was a feed corridor, in which the boar was carried. After pregnancy detection, gilts and sows were transferred to group housing and were fed using automatic feeding machines. The feed ratio was based on the pregnancy stage and the condition of the sows.

Sows in advanced stage of pregnancy, farrowing and lactating were stabled in individual farrowing pens with slatted plastic floor and the farrowing house was divided into section. High-pregnant sows were transferred to a clean and disinfected farrowing house 7 to 10 days before the planned farrowing. Piglets were weaned at the age of 21 days with an average weight of 6 kg and 28 days with an average weight of 7 kg.

The gilts and sows were kept according to the welfare requirements and fed according to the norms.

4.2 Methodology

The statistical data was compared between two different lengths in lactation thus lactation till 21days (2013–2015) and lactation till 28days (2016–2019) respectively. From the named farm the effects of lactation on reproductive sow performance were analysed. The breeds of Large White and the Landrace and their combinations (LW × L), (L × LW) and (LW × L) × L or LW were used for this thesis.

One-way ANOVA and two-way ANOVA (Statistika.12, TIBCO®) were used for statistical analysis. The dataset has been cleared of outliers.

Number of live born piglets was chosen as the basic parameter of litter frequency, because it is used to estimate the breeding value for reproduction in the breeding program.

The number of piglets was followed with association with:

Age at weaning	21 days; 28 days
Year	from 2013 to 2019
Parity number	from parity 1 to parity 7
Genotype	LW; L; LW × L; L × LW; (LW × L) × L or LW (crosses sows)
Age at first farrowing	
Gestation length	≤ 114 days; ≥ 115 days
Farrowing interval	≤ 140 days; ≥ 141 days
Weaning to conception interval	≤ 4 days; ≥ 5 days

For the monitored data the following characteristics were calculated:

NL	number of litters
$\bar{x}$	mean
Min.	minimum value
Max.	maximum value
s	standard deviation – characterized by the dispersion of data – the smaller the lower the variability of the data
$s_{\bar{x}}$	standard deviation of the mean – indicates the error of estimating the population average
−95.00% - +95.00%	confidence interval – indicates the limits within which the average of the population lies with 95% probability

5. Results and discussion

5.1 Basic statistics

In the commercial farm were analysed the effects of the length of lactation between weaning after 21 days (2013–2015) and 28 days (2016–2019).

Table 2 below shows the basic statistical data of number of total born piglets, alive born piglets and weaned piglets in comparison to weaning days of 21 and 28 days respectively.

From the statistical data weaning at 28 days had a higher average of piglets compared to weaning at 21days. The number of total born piglets was higher to the sows that weaned at day 28 by (0.5 piglet) compared to day 21. The number of alive born piglets was higher when weaned at 28 days by 1.0 piglet compared at day 21. The average was greater weaning at 28 days showing an increase of 0.7 piglet.

There was little or no significant difference in the Min and Max values. The standard deviation was higher for both days to the number of total born compared to the number of alive born piglets.

Table 2. Basic statistical data – on the number of piglets weaned at 21 and 28 days

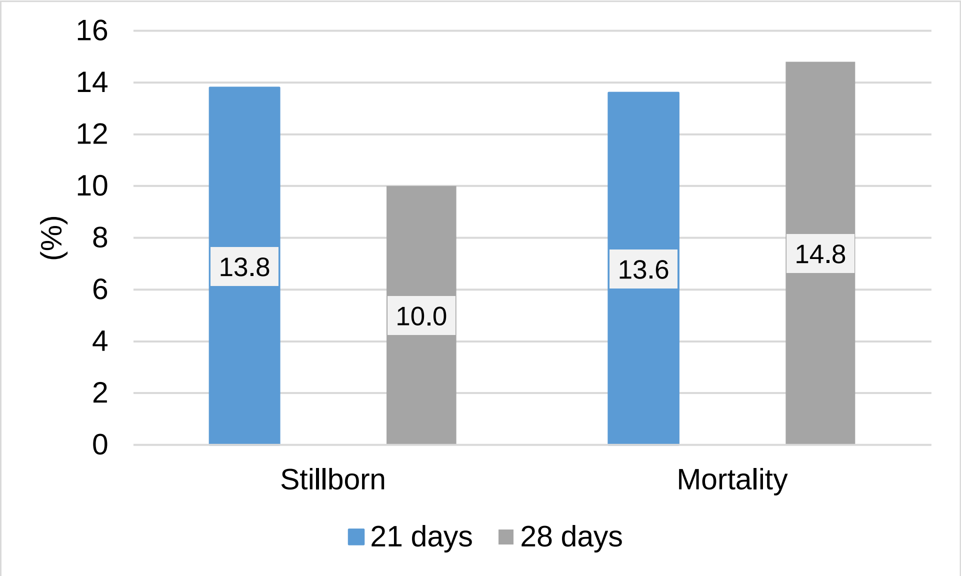
	Weaning	NL	$\overline{x}$	Min.	Max.	s
Total born	21 days	1 067	14.5	4.0	25.0	3.6
	28 days	929	15.0	4.0	26.0	3.5
Alive born	21 days	1 067	12.5	4.0	20.0	3.0
	28 days	929	13.5	4.0	20.0	3.2
Weaned	21 days	1 067	10.8	0.0	15.0	1.5
	28 days	929	11.5	0.0	15.0	1.4

Birth mortality is accessed by number of stillborn piglets in a litter. Among factors with an influence on birth mortality belong: size of litter, order of litter, age of sow, length of interval and birth weight of piglets (FISCHER, 2004).

The graph 1 below shows the percentages of stillborn and the mortality rate between weaning at 21 and 28 days respectively. There was a higher percentage of stillborn piglets to the sows that weaned at day 21 with an increase of (3.8%) compared to day 28. In comparison the mortality rate showed an increase to the mortality at day 28 with an increase of (1.2%) compared to day 21.

The higher mortality rate when weaned at day 28 was due to the fact that the sows had higher number of total born piglets and higher number of alive born piglets hence the care was more demanding as well as factors such as the technology and quality of personnel played huge factors to both weaning days.

Graph 1. Stillborn piglets and piglet mortality



HERMENT *et al.* (1994) mention that higher numerousness of litter causes higher percentage of stillborn piglets and it depends on occurrence of piglets with lower live weight and lower vitality.

Stillborn piglets are those that are apparently normal but die shortly before or during the parturition (LUCIA Jr. *et al.*, 2002). Litter size has been proven to play a significant role on the probability both of stillborn piglets and mummifications (BORGES *et al.*, 2005; CANARIO *et al.*, 2006; Correa *et al.*, 2007; LUCIA Jr. *et al.*, 2002; WEBER *et al.*, 2009; ZALESKI and HACKER, 1993). The risk of stillborn piglets is higher in first parity sows and in sows with five or more parities (BORGES *et al.*, 2005; Canario *et al.*, 2006; CORREA *et al.*, 2007). Litters with stillborn piglets will also have a higher mortality after farrowing, which indicates an overall lower viability of those litters in which stillborn piglets occur (LEENHOUWERS *et al*., 1999). Mortality of live born piglets during the nursing period are the most important causes of economic losses in a commercial piglet producing heard (BORGES *et al*., 2005; GRANDINSON *et al*., 2002; LAY *et al*., 2002).

5.2 Effect of year

As shown in the table 3 the highest average of number of total born piglets (15.7 piglets) was in 2019 and the lowest average number of total born piglets was in 2016 (14.2 piglets). The difference was 1.5 piglets (P < 0.05). Statistically significant differences were between years 2019 : 2013 till 2016. The standard deviation of the mean show no difference between the years 2014 and 2015 which were also the lost recorded compared to the highest recorded in the year 2019.

Table 3. Number of total born piglets – effect of year

Year	NL	$\bar{x}$	$s_{\bar{x}}$	-95.00 %	+95.00 %
2013	318	14.4[a]	0.20	14.0	14.8
2014	367	14.7[a]	0.18	14.3	15.1
2015	382	14.4[a]	0.18	14.0	14.7
2016	180	14.2[a]	0.26	13.6	14.7
2017	268	15.1[a.b]	0.22	14.7	15.5
2018	263	15.0[a.b]	0.22	14.6	15.4
2019	218	15.7[b]	0.24	15.3	16.2

[a,b] *– means with different letters differ significantly at P < 0.05*

Considering the rising reproductive performances of sows, which have been realized in the last decades and resulted in rising metabolic heat production of the animals, heat stress effects may even be expected under conditions of moderate climates (WEGNER *et al*., 2014).

Owing to their low sweating capacity, sows are very sensitive to high ambient temperatures. Negative effects of increased temperatures on sow reproduction include prolonged weaning-to-service intervals, increased numbers of regular and irregular returns to estrus, reduced litter size (EDWARDS *et al.*, 1968; ALMOND and

BILKEI, 2005; SURIYASOMBOON *et al.*, 2006) and reduced milk yield (RENAUDEAU and NOBLET, 2001).

Table 4 shows that the number of alive born piglets was recorded at its highest in the year 2019 with an average of 14.0 piglets which is an increase of 1.6 piglets (P < 0.05) compared to the year 2013 which recorded the lowest average of (12.4 piglets). Statistically significant differences were between years 2017 : 2013 till 2015; 2018 : 2013 till 2015 and 2019 : 2013 till 2016. The standard deviation of the mean recorded its highest in the year 2016 with an increase of 0.07 compared to the lowest recorded in the years 2015 and 2016 which between the two years did not show any difference the same applies to the years 2017 and 2018 as they had the same value of the standard deviation of the mean.

Table 4. Number of alive born piglets – effect of year

Year	NL	$\bar{x}$	$s_{\bar{x}}$	-95.00 %	+95.00 %
2013	318	12.4^{a}	0.17	12.1	12.7
2014	367	12.6^{a}	0.16	12.3	12.9
2015	382	12.5^{a}	0.16	12.2	12.8
2016	180	$12.8^{a.b}$	0.23	12.4	13.3
2017	268	$13.6^{b.c}$	0.19	13.2	13.9
2018	263	$13.4^{b.c}$	0.19	13.1	13.8
2019	218	14.0^{c}	0.21	13.6	14.4

^{a,b,c} – means with different letters differ significantly at P < 0.05.

5.3 Effect of parity number

Table 5 shows a significant statistical difference in the weaning averages between weaning at day 21 and day 28. Weaning at day 28 showed an increase in the average alive born piglets of about 1.0 piglets (P < 0.05). The standard deviation of the mean values were the same during both weaning days.

Table 5. Number of alive born piglets – effect of weaning time

Weaning	NL	$\overline{x}$	$s_{\bar{x}}$	-95.00 %	+95.00 %
21 days	1 067	12.4[a]	0.11	12.2	12.6
28 days	929	13.4[b]	0.11	13.2	13.6

[a,b] – *means with different letters differ* significantly at P < 0.05

Table 6 shows that as parity increases from parity 1 to parity 4 there is an increase in average alive born piglets and from parity 4 till parity 7 then average number starts to decrease as the parity increased. The highest average was recorded during parity 4 and the lowest during parity 7. The difference was 1.3 piglets (P < 0.05). Statistically significant differences were between parity 1 : parity 3 and 4 and between parity 7 : parity 3 and 4. The standard deviation of the mean value was recorded at its highest in parity 7 with an increase of (0.16) compared to the lowest in parity 3.

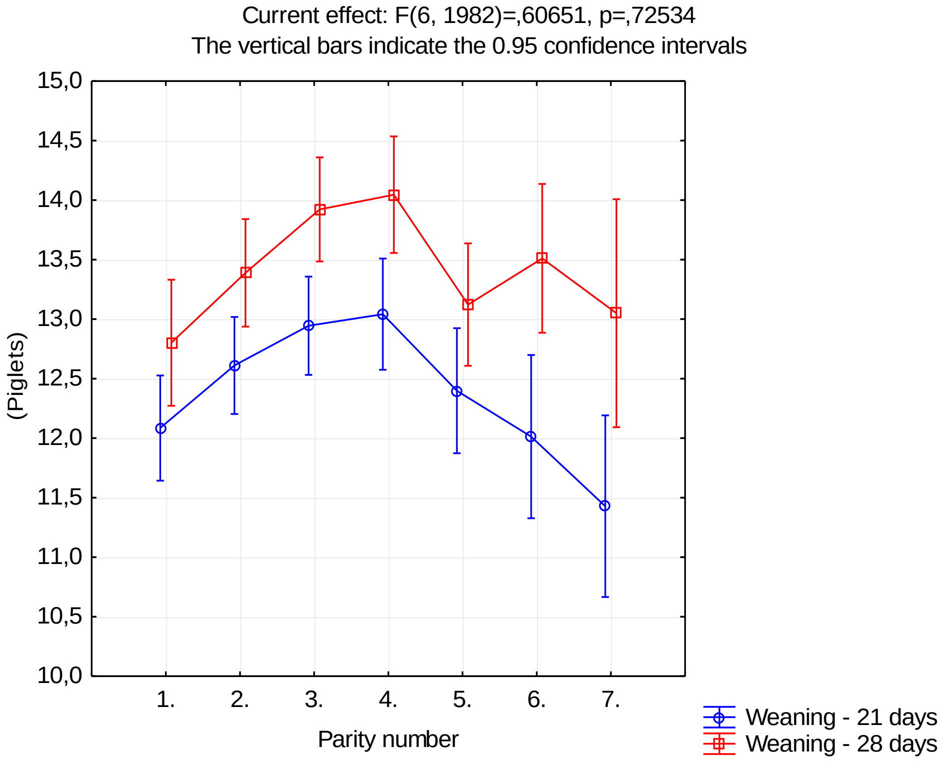
Table 6. Number of alive born piglets – effect of parity number

Parity	NL	$\overline{x}$	$s_{\bar{x}}$	-95.00 %	+95.00 %
1	319	12.4[a]	0.18	12.1	12.8
2	401	13.0[a.b]	0.16	12.7	13.3
3	408	13.4[b]	0.15	13.1	13.7
4	321	13.5[b]	0.17	13.2	13.9
5	272	12.8[a.b]	0.19	12.4	13.1
6	172	12.8[a.b]	0.24	12.3	13.2
7	103	12.2[a]	0.31	11.6	12.9

[a,b] – *means with different letters differ significantly at P < 0.05*

The graph 2 shows great variance in parity 6 and 7 when weaned at both day 21 and day 28. When weaned at day 28 it was noticed from parity 4 the average began to reduce to parity 5 but then there was an increase in parity 6 because it once again decreased in parity 7 while when weaned at day 21 it had increased from parity 1 till parity 4 then it gradually decreased from parity 5 till parity 7.

Graph 2. Number of alive born piglets – effect of weaning time and parity number



Lower parity females, especially primiparous sows, have longer weaning-to-first-service and weaning to conception intervals (BRIT, 1992) lighter litter weaning weights, and smaller subsequent litter sizes (CLARK, 1986).

The number of pigs born alive commonly increases with the parity number of the sow (SURIYASOMBOON *et al*., 2006). However, MORROW *et al.* (1992) in the USA reported that 41% of the herds and 54% of the sows show a decrease or similar number of piglets born alive in the second parity compared to the first parity sows, phenomenon called the second-litter syndrome.

As parity increases, piglet birth weights also increase, suggesting that once a sow has farrowed at least once, anatomical changes allow greater fetal development in subsequent litters. There was a positive trend in birth weights of piglets with increasing rank of parity. From the first parity, birth weights increased gradually, cumulated on the fifth parity, and then gradually decreased to the tenth parity (ČECHOVÁ, 2006).

Fertility of sow is not equal during the whole life. It increases from specific age and then it stays on the same level or mildly decreases. In sows number of piglets in a litter grows from the first till 3rd – 5th litter – period when sow reaches peak of the fertility. On 6th and next litter sows become pregnant reliably but they have more dead born piglets (FISCHER, 2004).

5.4 Effect of genotype

Table 7 shows a significant statistical difference in the weaning averages between weaning at day 21 and day 28. Weaning at day 28 showed an increase in the average alive born piglets of about 1.2 piglets ($P < 0.05$).

Table 7. Number of alive born piglets – effect of genotype

Weaning	NL	$\overline{x}$	$s_{\bar{x}}$	-95.00 %	+95.00 %
21 days	1 067	12.3[a]	0.13	12.0	12.6
28 days	929	13.5[b]	0.12	13.2	13.7

[a,b] – *means with different letters differ* significantly at $P < 0.05$

The table 8 shows that Large White breed had the highest average number of alive born piglets with an increase of (0.8 piglet) compared to the lowest recorded with the Landrace breed. The combinations of LW × L had a higher average of piglets of about (0.6 piglet) compared to the combinations of L × LW. No significant differences were in the averages among sows of different genotypes. The breed of Landrace had the highest standard deviation of the mean with (0.3).

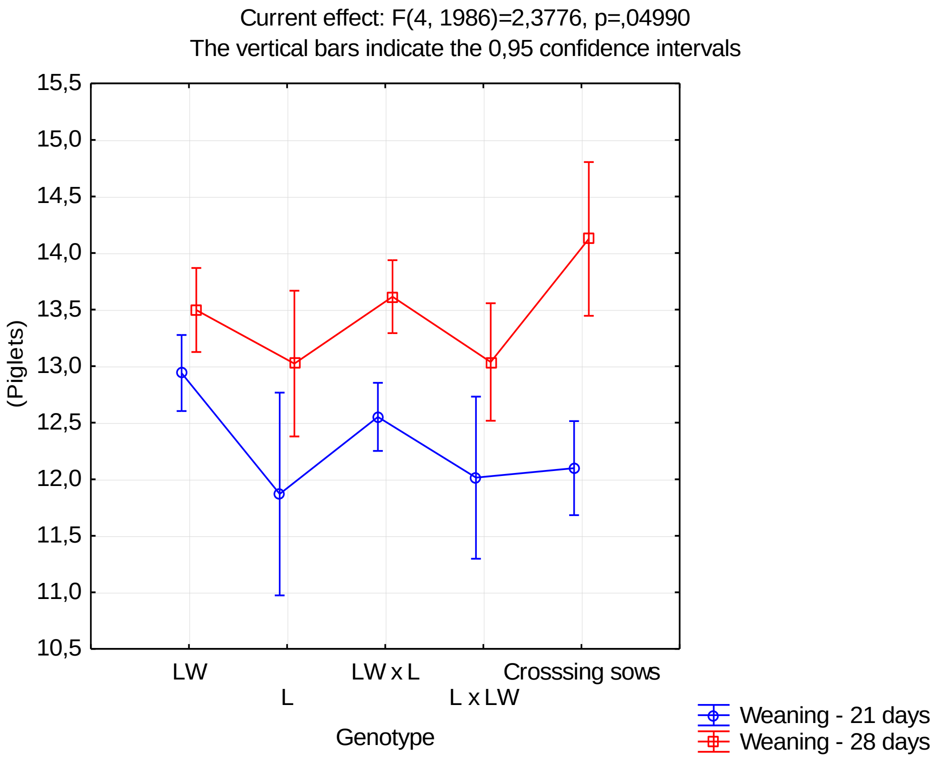
Table 8. Number of alive born piglets – effect of genotype

Genotype	NL	$\overline{x}$	$s_{\bar{x}}$	-95.00 %	+95.00 %
LW	595	13.2	0.1	13.0	13.5
L	135	12.4	0.3	11.9	13.0
LW × L	763	13.1	0.1	12.9	13.3
L × LW	209	12.5	0.2	12.1	13.0
Crossing	294	13.1	0.2	12.7	13.5

The graph 3 shows a huge noticeable variance in the Landrace breed when weaned at day 21 and a high variance with the combination of Landrace × Large

White. As for the weaning at day 28 it was noticed that the crossing sows had the highest variance.

Graph 3. Number of alive born piglets – effect of weaning time and genotype



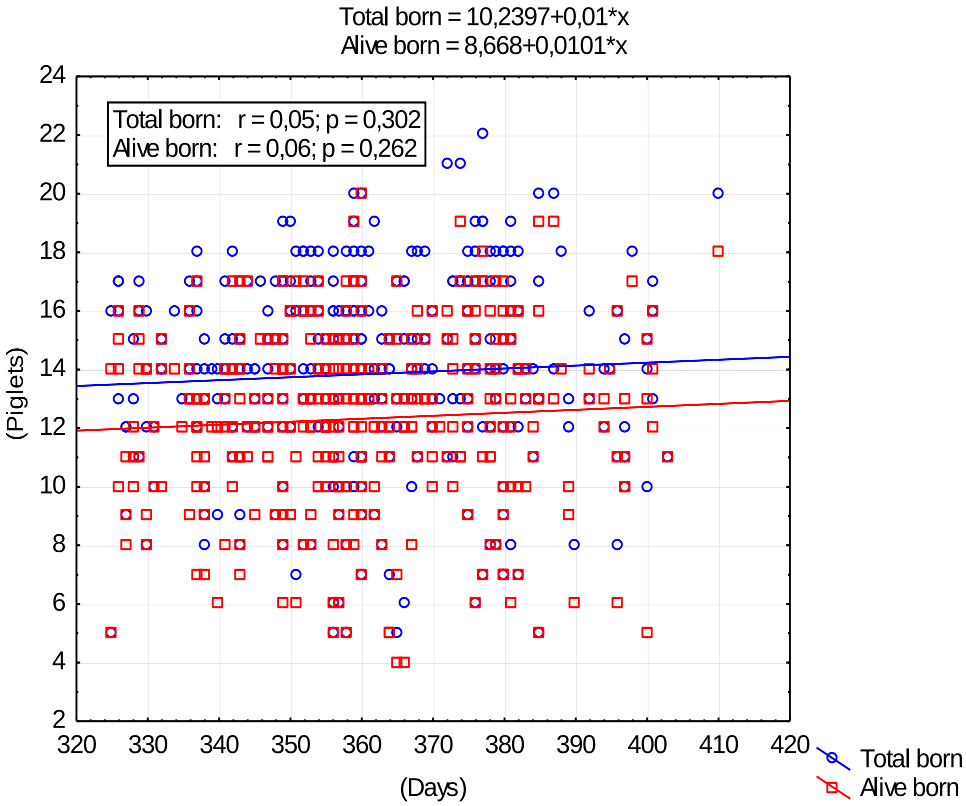
ŠPRYSL *et al.* (2010) say that the decisive step of breeders is the choice of suitable genotypes of sows ensuring profitable pig production. The genetics of sows and the order of litter have an impact on the number of live born piglets (COZLER *et al.*, 1998).

5.5 Effect of age at first farrowing

Graph 4 shows the correlation and regression relationships between the age at the first farrowing of gilts and number of born piglets.

The correlation coefficients between the age of gilts at the first farrowing and the number of total born piglets (r = 0.05) and the number of alive born piglets (r = 0.06) were evaluated as low, not statistically significant.

Graph 4. Effect of age at the first farrowing of gilt to number of piglets



The table 9 shows the average age at first farrowing at 360.1 days with an average of total born piglets being (13.8 piglets) and the average alive born piglets being (12.3 piglets).

Table 9. Age at first farrowing

	NL	$\overline{x}$	s	Min.	Max.
Age at first farrowing (days)	357	360.1	18.1	325.0	410.0
Total born piglets	357	13.8	3.3	5.0	22.0
Alive born piglets	357	12.3	3.1	4.0	20.0

5.6 Effect of gestation length

Table 10 shows a significant statistical difference between weaning at day 21 and day 28. Weaning at day 28 showed an increase in the average alive born piglets of about 0.9 piglets ($P < 0.05$).

Table 10. Number of alive born piglets – effect of genotype

Weaning	NL	$\overline{x}$	$s_{\bar{x}}$	-95.00 %	+95.00 %
21 days	1 067	12.6[a]	0.10	12.4	12.8
28 days	929	13.5[b]	0.10	13.3	13.8

[a,b] *– means with different letters differ significantly at P < 0.05*

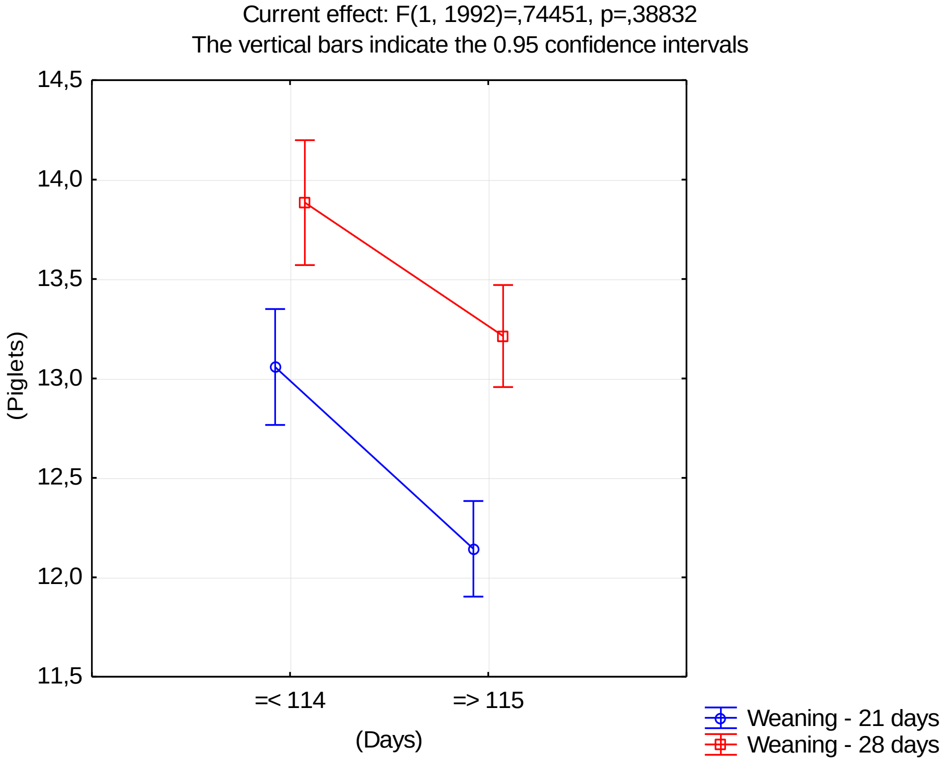
Table 11 shows a statistical difference in the average number of alive born piglets with sows equal to or less than 114 days had a higher average of about 0.8 piglets (P < 0.05) compared to gestation length equal to or more than 115 days.

Table 11. Number of alive born piglets – effect of gestation length

Gestation	NL	$\overline{x}$	$s_{\bar{x}}$	-95.00 %	+95.00 %
≤ 114 days	804	13.5[a]	0.11	13.3	13.7
≥ 115 days	1 192	12.7[b]	0.09	12.5	12.9

[a,b] *– means with different letters differ significantly at P < 0.05*

Graph 5. Number of alive born piglets – effect of weaning time and gestation length



The duration of gestation in sows can be influenced by a variety of factors, including parity, litter size, season and genetic background (SASAKI and KOKETSU, 2007; RYDHMER *et al*., 2008). Longer gestation length is related to a shorter duration of farrowing and has been associated with a higher occurrence of stillbirths. RYDHMER *et al.* (2008), for example, observed that sows with a gestation length <112 days had more stillborn neonates and fewer live born piglets, compared to those with a gestation length of 114–117 days; while in their study. SASAKI and KOKETSU (2007) reported that sows with a higher total number of piglets born had shorter gestation length.

In swine, longer gestation length positively correlates with piglet survivability, however, stillborn piglets are more frequent. Heavier birth weights also normally accompany longer gestation length (AUDREY EMERY,2018).

5.7 Effect of farrowing interval

The farrowing interval had a higher average number of alive born piglets when weaned at day 28 with an increase of 0.9 piglet (P < 0.05) compared to weaning at day 21 (table 12).

Table 12. Number of alive born piglets – effect of weaning time

Weaning	NL	$\overline{x}$	$s_{\bar{x}}$	-95.00 %	+95.00 %
21days	879	12.6[a]	0.15	12.3	12.9
28 days	798	13.5[b]	0.12	13.3	13.8

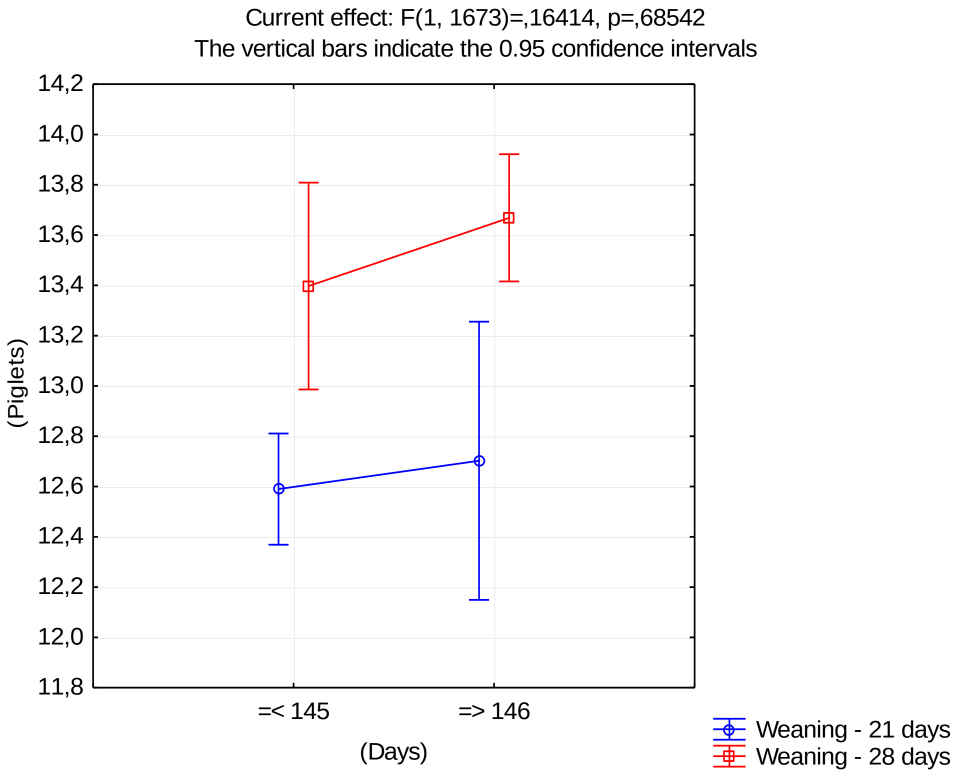
[a,b] *– means with different letters differ significantly at P < 0.05*

The table 13 shows how the farrowing interval with ≥ 146 days had a greater average number of alive born piglets by 0.2 piglet in comparison to the average when the farrowing interval was ≤ 145 days.

Table 13. Number of alive born piglets – effect of farrowing interval

Farrowing interval	NL	$\overline{x}$	$s_{\bar{x}}$	-95.00 %	+95.00 %
≤ 145 days	977	13.0	0.12	12.8	13.2
≥ 146 days	700	13.2	0.16	12.9	13.5

Graph 6. Number of alive born piglets – effect of weaning time and farrowing interval



As lactation length decreases there is an increase in the weaning-to-estrus interval, a decrease in farrowing rate, a decrease in subsequent litter size and an increase in pigs weaned per sow per year (DONALD *et al.*, 1997).

5.8 Effect of weaning to conception interval

The table 14 shows an increase in the average to the number of alive born piglets at day 28 with an increase of 0.9 piglet (P < 0.05) compared to day 21.

Table 14. Number of alive born piglets – effect of weaning time

Weaning	NL	$\bar{x}$	$s_{\bar{x}}$	-95.00 %	+95.00 %
21days	1 042	12.6[a]	0.10	12.4	12.8
28 days	798	13.5[b]	0.11	13.3	13.7

[a,b] – means with different letters differ significantly at P < 0.05

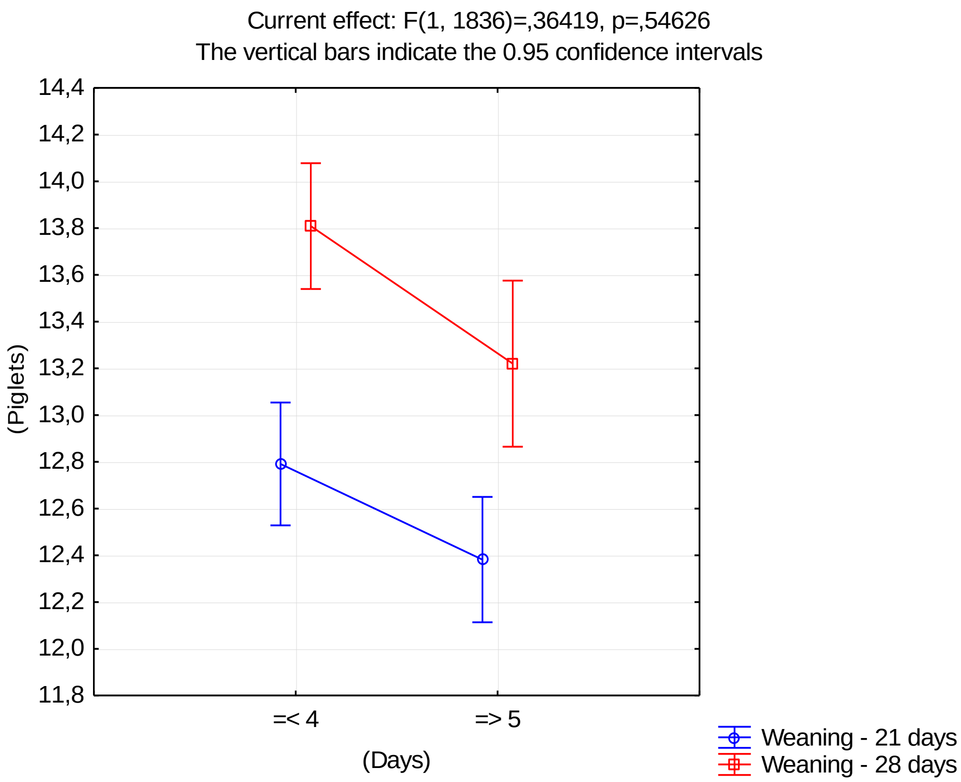
The table 15 shows an increase in the average to the number of alive born piglets in sows with weaning to conception interval (WCI) ≤ 4 days with an increase of 0.5 piglet (P < 0.05) compared to WCI ≥ 5 days.

Table 15. Number of alive born piglets – effect of WCI

WCI	NL	$\bar{x}$	$s_{\bar{x}}$	-95,00 %	+95,00 %
≤ 4 days	1 038	13.3[a]	0.10	13.1	13.5
≥ 5 days	802	12.8[b]	0.11	12.6	13.0

[a,b] – means with different letters differ significantly at P < 0.05

Graph 7. Number of alive born piglets – effect of weaning time and WCI



According to the PIC methodology (2017), the target is that the weaning to the first farrowing interval is below 6 days for sows after litter and 21 days below 5.5 days for sows with lactation duration and 28 days below 5 days for sows with lactation duration 28 days.

6. Conclusion and recommendations

The aim of the master´s thesis was analysed the effects of the length of lactation between weaning after 21 days (2013–2015) and 28 days (2016–2019) in the commercial farm.

1. Basic statistics

– The number of total born piglets was higher to the sows that weaned at day 28 (15.0 piglets) by 0.5 piglet compared to day 21. The number of alive born piglets was higher when weaned at 28 days (13.5 piglets) by 1.0 piglet compared at day 21. The average was greater weaning at 28 days (11.5 piglets) showing an increase of 0.7 piglet.

– There was a higher percentage of stillborn piglets to the sows that weaned at day 21 (13.8%) with an increase of (3.8%) compared to day 28. In comparison the mortality rate showed an increase to the mortality at day 28 (14.8%) with an increase of 1.2% compared to day 21.

2. Effect of year

– The highest average of number of total born piglets (15.7 piglets) was in 2019 and the lowest average number of total born piglets was in 2016 (14.2 piglets). The difference was 1.5 piglets ($P < 0.05$). Statistically significant differences were between years 2019 : 2013 till 2016.

– The number of alive born piglets was recorded at its highest in the year 2019 with an average of 14.0 piglets which is an increase of 1.6 piglets ($P < 0.05$) compared to the year 2013 which recorded the lowest average of (12.4 piglets). Statistically significant differences were between years 2017 : 2013 till 2015; 2018 : 2013 till 2015 and 2019 : 2013 till 2016.

3. Effect of parity number

– As parity increases from parity 1 to parity 4 there is an increase in average alive born piglets and from parity 4 till parity 7 then average number starts to decrease as the parity increased. The highest average was recorded during parity 4 (13.5 piglets) and the lowest during parity 7 (12.2 piglets). The difference was 1.3 piglets ($P < 0.05$). Statistically significant differences were between parity 1 : parity 3 and 4 and between parity 7 : parity 3 and 4.

4. Effect of genotype

– Large White breed (13.2 piglets) had the highest average number of alive born piglets with an increase of (0.8 piglet) compared to the lowest recorded with the Landrace breed (12.4 piglets). The combinations of LW × L (13.1 piglets) had a higher average of piglets of about 0.6 piglet compared to the combinations of L × LW (12.5 piglets). No significant differences were in the averages among sows of different genotypes.

5. Effect of age at first farrowing

– The average age at first farrowing at 360.1 days with an average of total born piglets being (13.8 piglets) and the average alive born piglets being (12.3 piglets).

– The correlation coefficients between the age of gilts at the first farrowing and the number of total born piglets ($r = 0.05$) and the number of alive born piglets ($r = 0.06$) were evaluated as low, not statistically significant.

6. Effect of gestation length

– A statistical difference in the average number of alive born piglets with sows equal to or less than 114 days (13.5 piglets) had a higher average of about 0.8 piglets ($P < 0.05$) compared to gestation length equal to or more than 115 days (12.7 piglets).

7. Effect of farrowing interval

– The farrowing interval with ≥ 146 days (13.2 piglets) had a greater average number of alive born piglets by 0.2 piglet in comparison to the average when the farrowing interval was ≤ 145 days (13.0 piglets).

8. Effect of weaning to conception interval (WCI)

– There was an increase in the average to the number of alive born piglets WCI ≤ 4 days (13.3 piglets) with an increase of 0.5 piglet ($P < 0.05$) compared to WCI ≥ 5 days (12.8 piglets).

Recommendations for practice

For future practice I would like to recommend the following ideas and practices.

1. Number of total number of piglets

- In order to attain a higher number of weaned piglets per year from sows it is advised to shorten the length of lactation though this is related to low weaning weights.
- Extension of lactation length increases the weaning weight of the piglets but also increases the risk of crushing or piglet mortality.
- Extension of lactation length requires better quality of personnel as well as the technology.

2. Improved quality of personnel

- The presence of personnel during the labour plays a huge role in the successful survival of both the piglets and the sow, this is because they can quickly intervene during the labour if necessary.
- Importance of training the personnel in accordance with the modern methods and technologies in reproduction.
- Introducing the importance of night shifts to the personnel as the most mortality cases after birth occur during the night hours. Due to the high frequency of natural births and higher mortality of piglets at night, the presence of a night nurse is not only necessary but also economically advantageous. The presence of a care taker during night births is also the subject of a subsidy under the welfare improvement program.

3. Milk intake

- For the survival of the piglets, colostrum intake within the first hours after birth is essential for the survival of the piglets till they are weaned.
- Use of split sucking method to allow the smaller or weaker piglets to suck on milk.

4. Genotype and modern technologies

- Due to the changes in the sows reproduction technologies and genetic progress, it has been noted that since 2013, the average number of piglets born has increased over the years.

- To maximize the genetic potential of the sows I would advise the use of hyper prolific lines as they have higher average of total piglets born even in higher parities.
- Technologies used should be in accordance with the welfare of the sows and piglets.

5. Effects of years

- During hot summer years it was noticed that the sow reproduction was affected by the high temperatures. The sows reduced on feed intake which affected the fertility of some sows.
- It is advised to have good ventilation and air circulation within the farrowing sections as well as unlimited access to drinking water. It is also advised to sprinkle the sows with cool water to cool down their bodies due to sensitivity to high temperatures. The high temperatures have a negative impact on estrus of the sows which means that the sows have irregular returns to estrus, reduced litter size as well as reduced milk yield.

6. Parity number

- I would advise to use the sows till the 7th parity and after repopulation is necessary as they begin to have low number of piglets as well as reduced milk yield.

7. Age at first farrowing

- Starting the reproductive cycle earlier shortens the unproductive period, which has a positive effect on the economy of production though the physiological and somatic state of development of sows may be insufficient to the birth and rearing of numerous offspring.
- Age at first farrowing primarily depends on the effectiveness of the first service. Serviced gilts in the second spontaneous estrus, provides the optimal period for the physical and hormonal development of the gilts while starting the reproduction considering that every inefficient servicing prolongs the age of farrowing of gilts but does not show any significant effects on their reproductive performance.
- To achieve a higher number of piglets, the gilts must be serviced within 9 months at the latest which increases the number of piglets per year.

- Service of gilts later than 230 days of age is also the subject of a subsidy under the welfare improvement program.

8. Gestation

- Non-pregnant, non-lactating females decrease the reproductive efficiency and increase the number of unproductive days. They generate production costs and occupy space in breeding and gestation facilities, yet they do not participate actively in the production of piglets. To avoid this I would advise early diagnosis of pregnancy so that the non-pregnant gilt or swine can be repeatedly inseminated when the return to estrus.

9. Weaning age

- Weaning age depends on the level of zoo technical management of each farm and technologies. It also depends on the quality of zoo technical care. Below are a few advantages of weaning at day 21 and 28.

  a) Weaning at 21 days

  Benefits or advantages

  - Higher number of litters per year,
  - Better condition of sows (sows breastfeed 7 days less, do not lose much weight).

  Disadvantages

  - Lower piglet weight at weaning higher costs of feeding piglets after weaning (the cheapest feed for piglets is breast milk)

  b) Weaning at 28 days

  Benefits or advantages

  - Higher piglet weight at weaning, these piglets grow better in later stages of fattening,
  - From the sow’s point of view – the uterine involution is terminated (the sow can get pregnant easily) and lactation is already behind the top,
  - In accordance with the welfare standards.

  Disadvantages

  - Lower number of litters per year (by 0.1–0.2), higher demands on sows' nutrition at the time of breast-feeding (but lower costs than feeding piglets with milk replacer).

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