

General reproductive properties in pigs

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Abstract: Pig breeding is usually undertaken for fat and meat production, but different sectors (cosmetics industry, pharmaceutical industry, medical sector, etc.) can also use pigs for alternate purposes. Pork is evaluated based on the status of an amended law regarding butchers' meat in Turkey. There have been 25 pig farms registered in Turkey since 7 July 2006 in the framework of compliance with the European Union. On average, a sow has 2.3 farrowings per year, producing 9.5 to 12.5 piglets per litter. It is important that high proportions of selected replacement gilts reach puberty at an early age in order to easily become pregnant and enter sow groups at weaning. A sow has an average of only 3 litters before her productivity wanes and she is sent to slaughter at an age of 24–30 months. Due to prolonged confinement, lack of exercise, and selective breeding for large size, culled sows often experience lameness, foot injuries, weakened bones, muscle atrophy, and painful abrasions.

Key words: Pig, puberty, estrus cycle, pregnancy, parturition, reproduction

1. Introduction

An understanding of the sow's reproductive system is essential for successful management programs. During the past 20 years, significant improvement in swine nutrition, housing, waste management, and mechanization has been achieved. Reproductive efficiency is a major limitation to profit in farrow-to-finish and feeder pig production units. A sow can produce 25 pigs or more each year. Improving reproductive efficiency reduces both overhead costs and feed costs per pig sold. Increasing the number of pigs marketed per female could reduce the number of sows needed or increase the total number of pigs marketed per year.

The present article was written to provide pertinent information about reproductive management for producers, managers, herdsmen, veterinarians, consultants, extension advisers, teachers, students, and others concerned with pig production systems. It contains sections dealing with all reproductive cycles from puberty to farrowing, the factors affecting the reaching of puberty, the management of reproduction, and the practical application of the techniques of pregnancy determination and termination of pregnancy or parturition.

2. Puberty

Pigs usually reach puberty at approximately 180–220 days of age. Moreover, a body weight of 100–110 kg is

required. The age of puberty varies depending on genetic and environmental factors including season, social environment, and nutrition. Factors affecting the age of puberty have been reported by Senger (1) as follows:

2.1. Age and weight

Extreme weakness delays puberty age and has a negative impact on lifelong reproductive performance (2). Birth rate, live birth rate, and weaning mortality are reduced in piglets with induced early puberty. However, these effects are only observed in pigs mated after 270 days (3).

2.2. Stock

Mixed breeds reach puberty earlier than pure breeds. The Meishan breed reaches puberty early (about 97 days), while the Duroc breed reaches puberty late (about 235 days) (3).

2.3. Genotype and body condition score

Management systems of the pig industry have improved since the 1970s. Moreover, new genotypes have been developed in order to produce high quality pork and to satisfy the requirements of the market. Beltranena et al. (4) noted that an indicator of attainment of puberty is that the back fat thickness should be a minimum of 6 mm, and before the first mating, it should be a minimum of 3 mm thick.

2.4. Feeding

Short-term changes in feed intake do not change live weight or body condition, but they can adversely affect reproductive function (4).

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2.5. Housing

Overcrowding reduces the rates of females showing estrus and reaching puberty (3).

2.6. Season

According to Peltoniemi et al. (5), the rate of gilts reaching puberty within 225 days of age is greater in winter (56%) than in summer (7%). An additional factor that can cause a delay in puberty is heat stress (6).

2.7. Environmental atmosphere

A low quality of ambient air contributes to a delay in puberty in gilts (7).

3. Inducing puberty

Hormonal supplements can be used to induce the first estrus in prepubertal females.

Puberty in young pigs can be induced by a single injection of 5 mL of PG600 (Intervet). PG600 is a combination of 400 IU of pregnant mare serum gonadotropin (PMSG) and 200 IU of human chorionic gonadotropin (hCG). After the hormonal treatment, young pigs enter heat within approximately 7 days at a rate of 50%–70% (5,8).

4. Sexual cycle

Domestic pigs are generally polyestric. However, European wild sows usually show estrus 2 times per year, in late fall and in April, depending on the season (9).

The estrous cycle in domestic pigs is usually 21 days depending on the breed and seasonal differences. The estrous cycle includes the following 4 stages:

1) Proestrus lasts about 1–3 days and is more pronounced in young females with vulvar hyperemia. The female allows the male to approach but not to mount.

2) Estrus has a duration of about 2–3 days, and ovulation takes place in the last third of estrus, 36–44 h after its onset. The vulva is hyperemic and edematous in pigs in estrus. There is vaginal discharge. Behavioral changes such as an increase in activity, tracking of moving objects, shouting, and irritability are observed. More often than in other animals, mounting and frequent urination in the presence of males are observed in female pigs. The mating position (remaining still and standing with 4 feet in extension) and upright ears are the other signs of estrus. The mating posture, with back or waist straight with both front feet touching, and the smelling of male pheromones can also be observed visually.

3) Metestrus lasts about 2 days and is very similar to diestrus.

4) Diestrus lasts about 14 days and during this time, females strongly reject the mating claims of males (9–11).

5. Estrus detection

Estrus is usually monitored twice daily (mornings at 0700 hours and evenings at 1700 hours) on pig farms.

Sometimes, because of the working routine of the farm, estrus is monitored once at the end of the working day, about 30 min to 1 h before or after feed intake. The first methodology increases the likelihood of determining the onset of estrus as well as the possibility of fertilization after the performance of artificial insemination (12).

6. Estrus synchronization

In cyclic pigs, prostaglandin F_{2α} (PGF_{2α}) or its analogs cannot be used to regress the corpus luteum up to day 12 of the sexual cycle. Therefore, up to this day of the estrus cycle, PGF_{2α} cannot be used for synchronization. One synchronization method used in adult pigs is gonadotropin treatment, which is also used for sows at weaning to prevent a delayed return to estrus associated with season and parity. An alternative dose and length of protocol of PGF_{2α} can be very useful and profitable (13,14).

To shorten the weaning–estrus and anestrus interval, 2 mL of Lutalyse® (dinoprost tromethamine) can be injected the first 24 h after birth and 5 mL of PG600 can be applied during the subsequent weaning treatment. Estrus is usually observed 3–7 days after this practice (15).

Another method of synchronization is the oral administration of progestin (Regumate®, Intervet) for a period of 14–18 days. Usually, 95% of treated sows display estrus 4–9 days after the cessation of treatment (16).

Recently, a methylcellulose gel vehicle (OvuGel®; Pennatek, LLC) used intravaginally after birth to stimulate estrus was developed. When 100 g of triptorelin is combined with this gel 96 h after weaning, the length of estrus, the estrus-to-ovulation interval, and the weaning-to-ovulation interval are all found to be reduced (17).

7. Mating time, achievement of blastocyst, and placentation

In pigs, mating lasts about 5–20 min, and 200–250 mL of sperm fills the cervix and uterus after each ejaculation. Afterwards, the behavior of the sow changes and it does not allow the boar to mount for the next 1–2 h. In natural mating, a boar could mate with a female up to 8 times, while a sow must be mated 3 times to increase the possibility for fertilization (12).

Blastocyst development in pigs is much faster than in other domestic animals. By the 10th day, it reaches 2 mm in diameter, and in the following 24–48 h it reaches 200 mm in length, which indicates that the blastocyst grows about 4–8 mm/h. Pig embryos can reach a diameter of 800–1000 mm by the 16th day. Another important point that differentiates pigs from other mammals is that, for pigs, the maternal recognition of pregnancy is achieved by the presence of at least 2 embryos in each cornu. Otherwise, PGF_{2α} is synthesized and the pregnancy is terminated with luteolysis (1).

The pig placenta is of the “placental epitheliochorialis villosa diffusa” type. In pigs, the first placental attachment occurs around the 12th day and placental connection reaches a sufficient development level 18–20 days after ovulation (1).

8. Pregnancy

The average gestation period is 114 days (range: 101–128) in domesticated pigs and can be up to 124–140 days in wild pigs. Furthermore, all embryos are not of the same size. Some may be defective, while others may be less developed. Until the first 10 days, many embryos can be absorbed, while up to the 20th day, total embryo loss can be about 40%. This is one of the most important factors that determine litter size (1,18).

9. Pregnancy recognition

9.1. Management

Since an open sow will recycle in 18–22 days after mating, pigs that do not return to estrus can be considered as pregnant. However, anestrus, ovarian cysts, and silent heat should be kept in mind in such situations.

9.2. Clinical methods

9.2.1. Ultrasonography

9.2.1.1. Transcutaneous ultrasonography

Transcutaneous ultrasound can be applied in the right lateral ventral abdomen of a standing sow, lateral of the teats and about 5 cm caudal to the umbilicus. With the aim of keeping the animal calm, food should be given during an ultrasonography (9,19).

Embryos of 19–20 days can be detected using a transcutaneous ultrasound technique with a 5-MHz probe (20).

9.2.1.2. Transrectal ultrasonography

To apply this method, the animal's feces must be removed by hand as much as possible. After that, the probe is inserted into the rectum. In this application, the probe should not be thicker than 2–3 cm and should not be longer than 10 cm (9).

Transrectal examination of pregnant and nonpregnant uterus by ultrasound.

A nonpregnant uterus is difficult to precisely determine in pigs because of the curved structure of the uterus. A pregnant uterus can be identified in different ways depending on the duration of pregnancy. Embryos can be detected at 18 days of pregnancy using a transrectal ultrasound with a 7.5-MHz probe (20).

From 0 to 20 days of pregnancy: Before the 20th day of pregnancy, diagnosis is based on the detection of embryonic fluid. In the first 20 days of pregnancy, diagnosis by ultrasound is not practical and may lead to incorrect diagnosis (21).

From 20 to 115 days of pregnancy: After the 20th day, embryos can be seen, and within a few days the heartbeat can be monitored. Embryos are about 8–10 mm in diameter. Embryos are 20–30 mm on day 28, and they reach a diameter of approximately 35 mm on day 35. On the 40th day, body length (crown–rump length) reaches a diameter of 50 mm, and on the 50th day it is 100 mm. After nearly 30 days, the embryo's abdomen, head, and extremities can be distinguished (21).

9.3. Laboratory methods

9.3.1. Vaginal biopsy

This method counts the number of epithelium layers in the vaginal mucosa. The required material can be obtained by biopsy at 20–25 days of pregnancy (9).

9.3.2. Plasma progesterone (P4) level measurement

Progesterone levels drop quickly on day 16 of the normal cycle of nonpregnant pigs. A high concentration of P4 in the plasma can be detected between 16 and 24 days of pregnancy. A P4 level of ≥ 7.5 ng/mL is an indicator of pregnancy, and the accuracy of the method for pregnancy diagnosis is about 96% (9,22).

9.3.3. Measurement of plasma estrone sulfate levels

Pregnancy diagnosis by the determination of estrone sulfate levels can be done at 24–30 days of pregnancy, when a high concentration of it is present in the blood plasma. At 35–45 days of pregnancy, estrone sulfate decreases to a low concentration, while a second increase occurs at 70–80 days and continues until farrowing. The advantage of this method compared to other methods is that it can be done with less blood because a small amount of blood taken from an ear vein is enough (9).

10. Termination of pregnancy and stimulation of birth

PGF₂ α or any synthetic analogs can be used to terminate pregnancy at any stage of the pregnancy. When 10 mg of PGF₂ α or 175 mg of cloprostenol is applied intramuscularly on the 112–113th days of pregnancy, farrowing takes place 20–36 h after treatment. Stimulation using a single daily dose of 75–100 mg corticosteroid applied on days 101–104 leads to birth by farrowing on day 109, but this procedure is not practical because it is expensive and reduces the number of live-birth piglets (9,16,23,24).

Usually a single dose of cloprostenol leads to an inadequate release of prostaglandin and, when used in conjunction with oxytocin, can be used to stimulate the release of hormones. Hence, the stimulation of birth in farm conditions can be done with a combination of these 2 hormones. If 0.18 mg of cloprostenol and 40 IU of oxytocin are used, farrowing will start 20–35 h later (23).

11. Parturition

A complex set of physiologic and endocrine events control parturition in the sow. The mechanism is unclear, and the

causes and effects of these events are either unknown or presumptive (10).

In the domestic pig, there is an increase in physical activity starting a few days before birth. Pregnant sows instinctively stay away from other pigs. In the last week of gestation, the vulva may become swollen and reddened, and 1–2 days before birth, a swelling of mammary glands, an increase in body temperature, and, in the later stages, small amounts of milk secretion are observed.

About 60%–75% of pig farrowings occur at night. The second stage of labor takes 150–180 min. Expulsion of the fetus requires strong myometrial and abdominal synergistic contractions, and the sows usually lie down during the expulsion of the piglets. The average time between the expulsions of 2 successive piglets is about 16 min (1).

An understanding of the sow's reproductive system is essential for a successful management program. Over the past 20 years, a significant improvement in swine nutrition, housing, waste management, and mechanization has been

achieved. However, the improvement of reproductive performance is much more difficult and time-consuming. Taking into account the aforementioned comments, it is necessary to follow sound management practices as well as a rigorous genetic selection program aiming to upgrade the reproductive parameters on swine farms.

12. Conclusion

Knowing about reproduction in the sow is important for the best system of breeding or the secret of success in any and all conditions. The most important component is the producer. The breeder must take the time to keep records, monitor the feed and breeding, keep facilities in good conditions, and watch the health status of the entire herd. However, the improvement of reproductive performance is difficult and time-consuming. Unfortunately, there are no quick and easy solutions to improving reproductive performance. It is necessary to follow sound management practices as well as a rigorous genetic selection program to upgrade reproductive parameters of swine farms.

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