Uses of **prostaglandins** in sows

Their most common use is to synchronise and induce farrowings. However, we also know of other applications that are beneficial to production.

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Prostaglandins are involved in the control of numerous gestation processes in sows (Stefańczyk-Krzymowska *et al*., 2005) and participate in:

- Regulation of the duration of corpora lutea.
- The growth and differentiation of endometrial cells.
- Uterine blood flow.
- Vascular permeability.
- Implantation and spacing of embryos in the uterus.

Heat and covers

Addition to seminal doses

Some studies have shown that adding exogenous prostaglandin $F_{2\alpha}$ to semen immediately before insemination improves cases of poor fertility, conception, and farrowing rates (Knox and Yantis, 2014; Horvat and Bilkei, 2003).

Aguarón (2008) observed that incorporating prostaglandins into seminal doses reduces the duration of heat and, therefore, the number of inseminations required.

In addition, a substantial improvement in fertility and in farrowing rates was seen with the use of $PGF_{2\alpha}$ or DL cloprostenol (which both have similar mechanisms of action). This is because of the more specific effects these molecules have on the uterine structures involved in the passive transport of sperm.

Prostaglandins are also administered at the time of artificial insemination.

This is interesting because, even though their addition implies an added expense, an obvious economic return is still obtained through their use by reducing the number of inseminations required (Aguarón, 2008).olucradas en el transporte pasivo de los espermatozoides.

Local treatment

Another means of administration that has been studied is local treatment. According to Stanisława ***et al.*** (2005), local administration of prostaglandins through the uterine artery, ovarian artery, or utero-ovarian vein was considered a useful means of regulating oviduct function.

In addition, the resulting adjustment of blood and lymphatic circulation in the mesometrial area created the ideal conditions for effective uptake and local retrograde transfer of $PGF_{2\alpha}$. These authors also proposed a possible mechanism for the participation of these processes in oestrous cycle regulation and early gestation in sows (Stefańczyk-Krzymowska ***et al.***, 2005).

In the peripartum period

Another line of research focuses on how applying prostaglandins and their analogues (such as cloprostenol) affects the prepartum behaviour of pregnant sows by triggering typical farrowing behaviour at earlier stages (Burne, Murfitt, and Gilbert, 2000).

There are also numerous applications for prostaglandins in the postpartum period (Veterinaria, 2003) during which it is known to affect:

- Lactation.
- The uterine involution process.
- Recovery from ovarian cyclicity.
- The number and survival of piglets in future farrowings.

The effects of prostaglandins on uterine involution and recovery from ovarian cyclicity have not yet been fully confirmed. However, recent research (Veterinary, 2003) found that applying prostaglandins 36 and 48 hours after farrowing promoted:

- Prolactin release.
- Better uterine tonicity. This would cause faster uterine involution and uterine emptying and, therefore, would have a preventive effect on uterine infections; in addition, it would encourage more complete luteolysis.

Productive results

A study by López *et al.* (2009), showed that a group of sows who had borne an average of 9.24 piglets per litter (of which 8.66 were born live) in their previous farrowing, bore:

- More piglets per litter— with an average of 10.71 and 11.00 piglets in the groups previously treated with cloprostenol and dinoprost after their previous weaning, respectively.
- More live piglets— with an average of 10.22 and 10.41 piglets, respectively.

Interestingly, a study by Vanderhaeghe *et al.* (2008) indicated that this increase in the number of piglets born in the same litter was only significant in older sows.

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There is also a practical interest in the postpartum application of prostaglandins in sows with MMA or vaginal discharges, high repetition rates, or low piglet viability rates (Veterinaria, 2003).

Exogenous contribution of $PGF_{2\alpha}$

- Exogenous prostaglandin increases plasma prolactin levels, which is thought to increase milk production in sows with mastitis, metritis, or agalactia (MMA).
- Some work claims that piglets farrowed by sows injected with $PGF_{2\alpha}$ gain more weight, as indicated by the higher average gain in these animals compared to those born to untreated sows (Veterinaria, 2003).
- Furthermore, postpartum injections of $PGF_{2\alpha}$ can lyse residual corpora lutea and therefore decrease progesterone concentrations, leading to increased milk production (Morrow *et al.*, 1996).

The physiology of farrowing

A good knowledge of the hormones involved helps to us understand the farrowing mechanism and thus, improve results related to this important moment.

The persistence of multiple corpora lutea (it is estimated that 4 or 5 are usually required) in sows is essential for the normal maintenance of pregnancy.

The average gestation time in sows is 114–116 days, with 10% farrowing before day 114 and another 10% farrowing after 116 days of gestation (Vanderhaeghe et Vlaams Diergeneeskundig Tijdschrift, 2012).

The maturation of foetuses produces an increase in foetal adrenocorticotropic hormone, which in turn stimulates the production of corticosteroids that cause uterine prostaglandin levels to rise.

It is well known that prostaglandins cause corpora lutea regression, which in turn, drastically reduces progesterone levels and triggers farrowing.

The physiology of farrowing is complex because several hormones act and interact in this process and together, mark the end of the gestation period.

This increase in $PGF_{2\alpha}$ influences the levels of other hormones involved in the farrowing mechanism (*figure 1*).

These hormones are responsible for the mammary gland development and the evident increase in vulvar size 2–3 weeks before farrowing. In addition, a few hours before farrowing, the sows start to become agitated, vulvar secretions start (*figure 2*), colostrum is expressed, and the sow's body temperature increases, among other signs.

One of the normal behaviours of sows is their construction of a nest prior to the start of farrowing, although this is now limited by intensive breeding conditions.

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Hormones involved in farrowing

- **Increased oestrogens:** which promote maternal behaviour in sows (nesting).
- **Increased relaxin:** this hormone dilates the birth canal.
- **Increased prolactin:** responsible for milk production.
- **Increased oxytocin:** this causes uterine and abdominal muscle contractions which encourages the birth of piglets and the expression of milk.

Farrowing duration

Farrowing usually lasts 1–6 hours, with extremes of less than 1 hour and more than 9 hours. Each piglet takes approximately 15 minutes to be farrowed and 25%–45% of them present backwards, without an increase in mortality. The longer the farrowing takes, the higher the neonatal mortality rate (which can exceed 33% when the farrowing exceed 6 hours). Most (75%) of this mortality occurs in piglets born during the final third of the farrowing.

Indeed, a study conducted by Thinkinpig in 2017 showed that the number of stillbirths doubled when the farrowing lasted longer than 5 hours.

Recommendations

To reduce the duration of farrowing, it is advisable to comprehensively check the following:

- Body condition of the sows.
- Quantity and quality of their feed.
- Quantity and quality of their water supply.
- That the area is calm.
- If possible, their last meal should have been consumed within 3 hours of the start of farrowing.
- Sow monitoring and manual and/or hormonal aid.
- Staff training.

Figure 2. Vulvar secretions just before the start of farrowing.

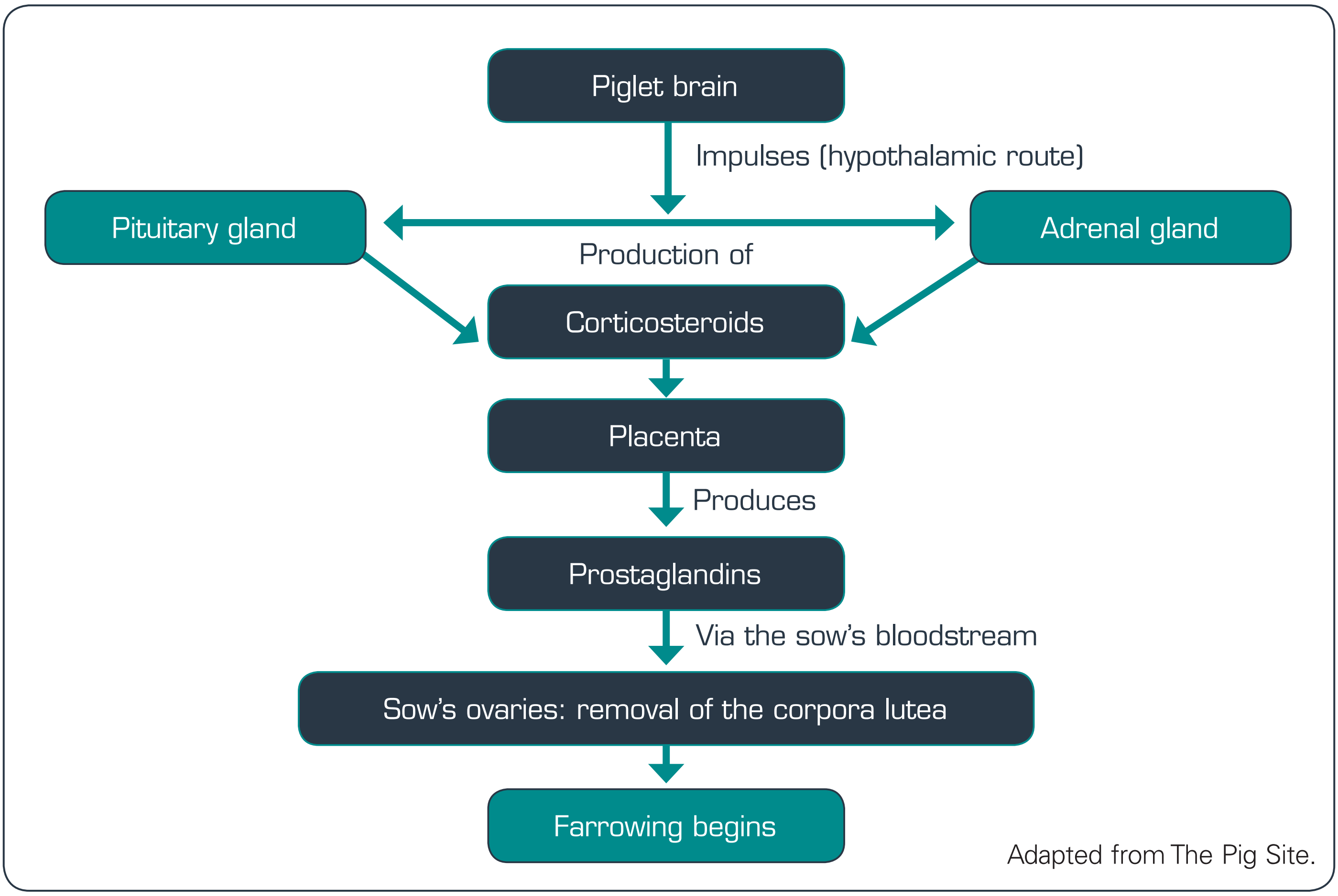

Figure 1. Diagram of the farrowing initiation mechanism and relationship between the hormones involved.

Induction of farrowing

The main reason for inducing farrowing is so that it can occur during working hours, thus allowing staff to monitor it. We must know the average length of gestation at the farm to safely carry out inductions and avoid problems.

At the hormonal level, farrowing induction is carried out by administering prostaglandin $F_{2\alpha}$, which accelerates progesterone reduction by up to 70% 12 hours after its application. At this point, the sow's uterus responds to the effects of oxytocin and the farrowing process begins. This process involves all the hormones mentioned above.

Importantly, farrowing induction does not affect:

- The rhythm of contractions.
- The expulsion of the piglets.
- Delivery of the placenta.

Therefore, there are no differences in the farrowing duration, number of live or dead births, or piglet vitality or the number of piglets weaned after induced or uninduced farrowings.

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Good farrowing care translates into a reduction in stillborn piglets and better farm management.

Advantages

- Reduce the number of farrowings that occur at night thus, as far as possible, maximising the number of daytime farrowings to take advantage of the availability of staff during working hours.
- Thoroughly monitor the farrowing with the goal of reducing stillbirths and mortality (King *et al.*, 1979; Holyoake *et al.*, 1995; White *et al.*, 1996).
- Concentrate the farrowings in order to better organise the majority of covers and farm tasks.
- Facilitate the management of piglets when fostering them and reduce the age range of the lot at weaning in order to achieve greater homogeneity.
- Prevent prolonged gestations.
- Optimise the maternity occupation rate.
- Favour the delivery of the placenta and prevent future cases of MMA syndrome.
- Better work the all-in/all-out system.

Disadvantages

- Do not apply too soon before farrowing because it can reduce piglet vitality at farrowing and reduce their colostrum intake.
- The induction period response lasts from 20 to 36 hours (but may be longer in some cases). An intramuscular injection of $PGF_{2\alpha}$, induces 50%–60% of farrowings within 22–36 h, and the administration of two separate doses 6 hours apart increases this figure to 87.5%. One way to reduce this period is to administer 10 IU of oxytocin 24 hours after the administration of $PGF_{2\alpha}$ if milk expression is observed in the sow.
- When farrowings are synchronised, they are always attended.
- Even though it is not carried out at every farm, synchronising farrowings positively affects the care administered to sows.
- Variability in the induction period.

Thus, it is also useful to know the number of stillbirths produced per cycle, both during attended and unattended farrowing phases, so that this number can be used as a reference if an increase in stillbirths during unattended farrowings is observed.

In one study (Thinkinpig, 2016), the application of prostaglandin from the fourth birth reduced the number of stillbirths by more than one piglet.

Tips for using oxytocin

If a single dose of $PGF_{2\alpha}$ is followed by the administration of oxytocin 6–22 hours later, the percentage of farrowings increases to around 80%.

The use of oxytocin:

- Oxytocin does not induce farrowing; never administer it if no piglets are present.
- Oxytocin should never be used indiscriminately because it can stop farrowing and increase the percentage of stillbirths when the cervix dilation is incomplete.
- Do not use it without first checking the birth canal.

The physiology of lactation

Mammary gland development begins long before farrowing occurs; these hormonal stimuli begin at puberty. Oestrogens are related to the development of branching ducts while progesterone is involved in mammary alveolus development.

Once the sow is pregnant, more hormones intervene in the process of mammary gland development:

- Oestrogens and progesterone continue to work in the same way they had since the onset of puberty.
- Prolactin, growth hormone (GH), and adrenocorticotropic hormone (ACTH) promote duct and mammary gland growth.

Together, the action of all these hormones prepares the mammary glands to produce milk at the time of the farrowing.

All these hormones act before the farrowing to prepare the mammary glands and, along with other hormones, are then responsible for maintaining milk production during lactation.

On the one hand, the decrease in progesterone levels in the days before farrowing make the mammary glands more receptive to the effects of prolactin and glucocorticoids, while on the other hand, progesterone loses its ability to inhibit lactation through this same mechanism.

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Hormonal changes

- **Prolactin:** the levels of this hormone increase two weeks before the farrowing and reach their highest level at the time of farrowing. This hormone starts and maintains milk production.
- **Insulin:** increases the permeability of mammary cells.
- **Glucocorticoids:** these increase at the beginning of lactation and interact with prolactin to favour its action.
- **Growth hormone (GH):** this favours the action of prolactin and glucocorticoids.
- **Progesterone:** negatively influences milk production because it inhibits the production of lactose, casein, and α-lactalbumin.

Another indispensable factor in maintaining lactation is the suckling stimulation by piglets (*figure 3*), which favours the secretion of prolactin and glucocorticoids.

Other effects of prostaglandins

1. Lactational anestrus

After farrowing, sows go into a state of anestrus due to the suckling stimulation of their piglets. At the hormonal level, plasma LH levels are low at that time.

When the stimulus from the piglets decreases or disappears, the sow's LH levels increase and follicle development resumes, leading to ovulation. In this process, FSH exerts its role in regulating follicles which will go on to mature.

Therefore, any factor that can decrease milk production during lactation can cause heat during this period.

2. Sows with porcine endometritis (dirty sow syndrome)

When farrowing is properly induced, regardless of the method used, the incidence of MMA syndrome reduces.

However, by using high doses of oxytocin (20–30 IU) and along with the need to better supervise farrowings, it has been found that more sows have higher body temperatures within the first three days after farrowing.

If these animals are not treated immediately, more than 10% if the sows can show clinical signs of MMA (becoming hypogalactic or agalactic, producing vaginal discharge, and/or manifesting mastitis and anorexia).

Figure 3. Suckling piglets produce a suckling stimulus in sows.

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