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Effect of a GnRH analogue (Maprelin) on the reproductive performance of gilts and sows

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ABSTRACT

The ability of peforelin (l-GnRH-III) to stimulate follicular growth, FSH release, and estrus in gilts after altrenogest treatment and in sows after weaning was investigated. In three farrow-to-wean herds, with at least 600 sows and average production performance, 216 gilts, 335 primiparous, and 1299 pluriparous sows were randomly allocated to three treatments: peforelin (M group: Maprelin), eCG (F group: Folligon), and physiological saline solution (C group). Animals were treated 48 hours after their last altrenogest treatment (gilts) or 24 hours after weaning (sows). The weaning-to-estrus interval, estrus duration, estrus rate (ER), pregnancy rate, and total born (TB), live born, and stillborn (SB) numbers were recorded and compared between treatments for the different parity groups (gilts and primiparous and pluriparous sows). Follicle sizes were measured in representative animals from each group on the occasion of their last altrenogest treatment or at weaning, and also on the occasions of their first (FS1) and second (FS2) attempted inseminations. Blood samples were taken to determine FSH concentrations at weaning and 2 hours after injection, and progesterone concentrations 10 days after the first insemination attempt. The relative change in FSH concentrations was calculated. Significant differences were found for ER within 7 days of weaning in pluriparous sows (95%, 91%, and 90% for the M, F, and C groups, respectively, $P = 0.005$). Gilts in the F-group had high TB numbers, and pluriparous sows in the M group had high SB numbers (TB gilts = 13.6, 15.4, and 14.9 [$P = 0.02$] and SB pluriparous sows = 1.8, 1.4, and 1.7 [$P = 0.05$] for the M, F, and C groups, respectively). The M group had the highest FS1 (for gilts) and FS2 (for pluriparous sows) values: FS1 = 5.4, 4.9, and 4.9 mm [$P = 0.02$] and FS2 = 6.8, 5.3, and 6.3 mm [$P = 0.03$] for the M, F, and C groups, respectively. There were no significant differences between the different treatments within each parity group with respect to any of the other variables. Overall, peforelin treatment had small but positive effects on the ER and follicle growth in certain parity groups but did not seem to affect litter sizes or FSH and progesterone levels in sows on the occasions of the corresponding examinations.

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1. Introduction

Maintaining optimal reproductive performance is essential for meeting economic targets in commercial pig production. Management strategies, including accurate feeding at different stages of breeding, batch farrowing,

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optimal housing, and a sufficiently long photoperiod in the insemination facility are not always sufficient to meet farmers' performance requirements. Pharmaceuticals, that is, hormones, can be used to manipulate the estrus cycle in swine, for example, to synchronize estrus and ovulation within a herd, which can increase reproductive performance [1]. In females that have undergone an estrus synchronization program, it is possible to inseminate multiple batches of sows within a short time frame—1 or 2 days—which results in a relatively synchronized onset of farrowing within these batches. These procedures are increasingly important, especially in herds where batch production systems for sows are used or will be used.

Treatment with exogenous gonadotropins in sows after weaning or in gilts after altrenogest treatment has been used to stimulate follicular development and to induce ovulation in prepuberal, cycling, lactating, and anestrus sows [2]. It has also been shown to improve the synchronization of estrus onset within batches [1,3,4]. In addition, gonadotropins have been used to decrease the weaning-to-estrus interval (WEI), which proved to be particularly helpful in sows that were at a high risk of reduced fertility during the post-weaning period, such as first parity sows [5] or animals experiencing seasonal infertility problems [6].

The release of LH and, to a lesser extent, FSH from the pituitary gland is governed by the hypothalamic GnRH [1,2,7,8]. GnRH is therefore a key regulator of the growth, maturation, and, ultimately, the ovulation of follicles. Whereas LH secretion is dependent on GnRH, FSH is not. Instead, the FSH levels are regulated by other peptides, such as gonadal activins, inhibins, and follistatins [8–10]. Twenty years ago, Sower et al. [11] reported for the first time that there is another selective FSH-releasing factor produced by the hypothalamus in fish—specifically, the lamprey, *Petromyzon marinus* (lamprey GnRH-III). This variant of GnRH was put forward as a potential FSH-releasing factor. Numerous subsequent *in vivo* and *in vitro* studies were conducted in different species, yielding inconsistent results. On the basis of *in vitro* and *in vivo* studies with rats, cows, and barrows, treatment with l-GnRH-III induces increases in the levels of FSH but not of LH [10,12–14]. However, studies on mid-luteal intact cows [15] and barrows [16] reported that l-GnRH-III only stimulates the release of LH and does not affect FSH. Still other studies indicated that treatment with 1-GnRH-III did not cause any increase in the levels of either FSH or LH in rodent brain tissues [17] or in gilts [1], but stimulated the secretion of both gonadotropins in rat pituitary cells [18] and ovariectomized cows [15]. To date, no studies have been conducted to explore the influence of l-GnRH-III on the secretion of the different reproductive hormones in gilts and sows at the same time.

Recently, a German company, Veyx, launched the product Maprelin, whose active substance is l-GnRH-III (peforelin). This agent is marketed for the induction of the estrous cycle in sows after weaning and in sexually mature gilts, in animals that have undergone progestogen therapy to inhibit the estrous cycle. Different studies conducted in Germany have suggested that treatment with peforelin (Maprelin, l-GnRH-III, Veyx-Pharma, Schwarzenborn, Germany) has positive effects on estrus induction in gilts and sows [19,20] and reduces the interval between the animals' most recent altrenogest treatment and the onset of estrus in gilts [21,22]. It may also decrease the negative effects of seasonal infertility [19].

The purpose of the study reported herein was to investigate the ability of peforelin to stimulate follicular growth and estrus in gilts after altrenogest treatment and in post-weaning sows, and to study its effects on litter size in Belgian farrow-to-wean herds with average production performance. In addition, FSH and progesterone (P4) levels in the studied animals were analyzed to investigate the effects of l-GnRH-III on FSH release and the ability of the CL to produce P4. The performance of the peforelin-treated animals was compared with that of a pregnant mare serum gonadotropin (ECG)-treated group and an untreated control group.

2. Materials and methods

The study was conducted between January 2010 and May 2011 and was approved by the Ethical Committee of the Faculty of Veterinary Medicine of Ghent University (approval: EC2010/035).

2.1. Herd selection, study animals, and management practices

Three farrow-to-wean herds in the province of West Flanders with at least 600 sows (600–1700) and an average reproductive performance for the Belgian swine industry were included in the study. Briefly, the number of weaned piglets/sow/year ranged from 23 to 27, and on average, 85% to 95% of the sows reported estrus within 7 days of weaning. More detailed information on the farms is presented in Table 1.

In total, 1945 gilts and sows (average: 650 per herd) were investigated during one reproductive cycle, starting at the point of weaning for sows or from their most recent altrenogest treatment for gilts, to their subsequent weaning (Table 1). Animals with clinical disease

Table 1
Characteristics of the three pig herds included in the study.

Characteristics	Herd A	Herd B	Herd C
Number of sows per herd	1200	1700	600
Number of sows included in study	627	685	633
Breed of sows	Danbred × York	PIC	Topigs20
Batch-production system for sows (weeks)	1	2	4
Lactation period (weeks)	3	3	3
Piglets weaned/sow/y	25.9	26.1	26.3
Average weaning-to-insemination interval (days)	7.0	7.1	7.8
Age of gilts at first insemination (days)	280	290	250

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