Patterns of plasma LH, FSH, oestradiol and corticosteroids from birth to the first oestrous cycle in Meishan gilts

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Hormonal changes associated with pubertal development in a breed of pig exhibiting early puberty were determined. In Expt 1, blood from prepubertal Meishan gilts was collected at about 1 ($n = 5$), 10 ($n = 5$), 20 ($n = 4$), 30 ($n = 5$), 50 ($n = 5$), 70 ($n = 10$), 80 ($n = 10$) and 90 ($n = 7$) days of age. In Expt 2, females were sampled between 99 and 116 days of age before ($n = 16$) or during ($n = 9$) the first oestrous cycle. Serial blood samples were collected through a jugular catheter at 20 min intervals. In Expt 2, age at puberty was determined by daily examination for oestrus and weekly evaluation of plasma progesterone and found to occur at 111 days of age. Hormone profiles determined at least 19 days before the first oestrus were grouped to constitute a prepubertal stage. In Expt 1, mean concentration of LH was high at 1 day of age, significantly lower at 10 days and showed nonsignificant variations until 90 days. Frequency of LH pulses increased between 10 and 50 days (0.42 versus 0.85 pulse h^{-1} , $P < 0.05$), decreased between 50 and 70 days (0.49 pulse h^{-1} , $P < 0.05$) and remained low thereafter. Amplitude of LH pulses was high between 1 and 30 days and declined progressively until 80 days. Mean concentration of FSH was high between 1 and 20 days and decreased progressively until 80 days (7.2 and 2.3 ng ml^{-1} , respectively, at 20 and 80 days, $P < 0.05$). Concentrations of oestradiol and corticosteroids were highest at day 1 and showed nonsignificant fluctuations between 10 and 90 days. The concentration of corticosteroids was higher in the morning than in the afternoon ($P < 0.05$) whatever the age. In Expt 2, comparisons with the prepubertal stage showed a mild increase in number of LH pulses ($P = 0.07$) 11–13 days before puberty, an increase in mean ($P = 0.07$) and baseline concentration ($P < 0.05$) of LH, in oestradiol concentration ($P < 0.05$) and a decrease in morning concentration of cortisol ($P = 0.06$) 4–6 days before puberty. After puberty, concentrations of LH (mean), FSH and progesterone were higher, whereas morning cortisol was lower at the beginning of the luteal phase than during the prepubertal stage ($P < 0.05$). At the end of the luteal phase, the only differences with the prepubertal stage were higher progesterone concentration and amplitude of LH pulses. Hormonal changes in Meishan gilts therefore show a similar pattern to that observed in European breeds of pig with a perinatal, an infancy, a juvenile and a waiting phase. Four to 13 days before puberty an increase in LH and a decrease in corticosteroid secretions are probably involved in stimulation of follicular growth which leads to the first ovulation.

Introduction

Genotype plays an important role in the determination of age at puberty. In female pigs, the first oestrus and ovulation normally occur between 5 and 8 months of age in European breeds (Christenson and Ford, 1979; Hughes, 1982) and at about 3 months of age in the Chinese Meishan breed (Cheng, 1983; Legault and Caritez, 1983). This latter breed is, therefore, a useful model to investigate the endocrine mechanisms that control onset of puberty. In European Large White gilts, pubertal at about 8 months of age, four phases of development related to ovarian development and gonadotrophin secretions have been

described between birth and puberty (Camous *et al.*, 1985): a perinatal phase (first month of life), an infancy period (second month of life), a phase of initiation of sexual development (third to fifth months of life) and a waiting period (sixth month of life until puberty). Antral follicles and follicles larger than 1 mm in diameter appear earlier in Meishan than in Large White females (at about 30 and 60 days versus 70 and 90 days, respectively) (Mauléon, 1961; Cheng, 1983; Prunier *et al.*, 1987; Miyano *et al.*, 1990). To our knowledge, the patterns of gonadotrophin and oestrogen secretions during sexual maturation have not been described in Meishan gilts.

A role for adrenal hormones in the sexual maturation of gilts has often been evoked even though the mechanisms by which

they are effective are unknown. In fact, management practices such as mixing, relocation and transportation of gilts, which induce an acute stress response, characterized by a rapid increase in plasma cortisol concentrations (Dantzer and Mormède, 1983), trigger the onset of puberty in European gilts (Du Mesnil Du Buisson and Signoret, 1962). Moreover, puberty is delayed in adrenalectomized gilts and advanced in intact gilts treated with synthetic glucocorticoids (Killian *et al.*, 1987). Finally, it has been shown that corticosteroids affect basal or GnRH-stimulated LH secretion (Fonda *et al.*, 1984; Pearce *et al.*, 1988) in European gilts. Development of the circadian rhythm of corticosteroids has recently been investigated in gilts from a European breed (Evans *et al.*, 1989). This study indicated that the circadian variations in blood concentrations undergo gradual modifications reaching adult profiles at, or shortly before, puberty. As far as we know, the development of corticosteroid secretion has not yet been described in Meishan gilts.

The objective of the present study was to describe the patterns of plasma LH, FSH, oestradiol and corticosteroids during sexual maturation of Meishan gilts.

Materials and Methods

Animals

Twenty gilts from five different litters born in December or April were used in Expt 1. Animals were maintained under natural light conditions throughout the experiment. Weaning was carried out between 21 and 23 days of age. From 50 days of age, animals were kept in individual pens and fed *ad libitum* with a standard diet. Ovulation was detected by collecting blood samples once a week from 80 days and a direct radioimmunoassay (Terqui and Thimonnier, 1974) was performed on plasma to determine whether the concentration of progesterone was higher than 5 ng ml^{-1} .

Fifteen gilts from four different litters born in June were used for Expt 2 and kept under the same conditions as animals in Expt 1. From 60 days of age, gilts were checked for onset of oestrus twice a day with pubertal boars. From 80 days, plasma progesterone was evaluated once a week. Age at puberty was defined as the age on the first day of the first oestrus accompanied by ovulation (day 0). Females were killed at 130 days of age.

Collection of blood samples

Serial blood samples were collected via an indwelling Silastic catheter (Table 1). At each age, one or two animals from each litter were sampled. In one-day-old piglets, a catheter was inserted into one umbilical artery immediately after birth, as described by Le Dividich *et al.* (1991). In older females, the catheter was inserted into one jugular vein under general anaesthesia ($1.5 \text{ l min}^{-1} \text{ O}_2$: halothane 96:4, vol:vol). Catheters were inserted at least 3 days before blood collection started. Samples were taken every 20 min, beginning at 09:00 h, for 7 h for females up to 10 days old and for 8 h in older females. The last samples taken between 16:30 h and 17:00 h on day 1 and day 10 were used for corticosteroid determination; the total

Table 1. Age and body weight (mean $\pm$ SEM) of gilts at time of collection of blood samples

Age group	Age (days)	Body weight (kg)	Number of hormone profiles
Experiment 1			
1	1–2	0.9 ± 0.1	5
10	9–10	1.9 ± 0.2	5
20	16–20	3.8 ± 0.4	4
30	30–31	6.9 ± 0.7	5
50	50–51	12.4 ± 1.3	5
70	71–72	22.4 ± 1.6	10
80	79–80	27.3 ± 1.9	10
90	87–90	28.5 ± 2.5	7
Experiment 2			
	99–116	31.7 ± 0.7	25

volume of blood drawn per piglet did not exceed 15 ml. Gilts were sampled two or three times with at least 9 days between samples. Plasma was collected after centrifugation (10 min at 1600 g) and stored at -20°C until assayed.

Assays

Concentrations of LH and FSH in plasma were measured by previously validated homologous radioimmunoassays (Camous *et al.*, 1985). LH was measured in all samples and FSH in samples collected at hourly intervals. For each experiment, both hormones were measured in single assays. Sensitivities were 0.7 and 0.5 ng ml^{-1} for LH and FSH, respectively, and intra-assay coefficients of variation were 8% at $1.7 \text{ ng LH ml}^{-1}$ and at $2.5 \text{ ng FSH ml}^{-1}$. Oestradiol was measured by radioimmunoassay (Thibier and Saumande, 1975) in pools made up of aliquots of all samples from one animal within a series of blood samples. Extraction procedures were slightly modified; 1 ml of plasma was extracted once with 5 ml of cold diethyl ether. The sensitivity of the assay was 5 pg ml^{-1} ; intra- and interassay coefficients of variation were 5% and 25%, respectively, at $410 \text{ pg oestradiol ml}^{-1}$. Corticosteroid concentrations were measured in samples taken at 09:00 h and between 16:30 h and 17:00 h, by a protein-binding assay after dichloromethane extraction (Mormède and Dantzer, 1978). Sensitivity of the assay was $1 \text{ ng corticosteroids ml}^{-1}$, and intra- and interassay variability averaged 7 and 10%, respectively.

Calculations and statistical analyses

Pulses of LH were identified according to the method described by Merriam and Wachter (1982). For each LH profile, the number of pulses h^{-1} , the mean concentration of all samples (mean concentration) and of interpulse samples (baseline) as well as the average amplitude of pulses (within-pulse maximal concentration minus baseline concentration) were determined. For each FSH profile, mean hormone concentration was calculated. In Expt 2, profiles were grouped according to the number

Table 2. Plasma profiles of LH, FSH and oestradiol in Meishan gilts from 1 to 90 days of age

Age group (days)	Plasma LH (ng ml ⁻¹)	Baseline plasma LH (ng ml ⁻¹)	Frequency of LH pulses (number h ⁻¹)	Amplitude of LH pulses (ng ml ⁻¹)	Plasma FSH (ng ml ⁻¹)	Plasma oestradiol (pg ml ⁻¹)
1	3.3 ± 0.4 ^a	2.7 ± 0.3 ^a	0.55 ± 0.09 ^{ab}	2.5 ± 0.4 ^{ab}	6.4 ± 1.8 ^{ab}	12.9 ± 2.4
10	2.3 ± 0.1 ^b	1.8 ± 0.2 ^b	0.42 ± 0.08 ^b	2.4 ± 0.5 ^{ab}	5.7 ± 2.0 ^{abc}	9.5 ± 2.2
20	2.2 ± 0.1 ^b	1.4 ± 0.1 ^b	0.72 ± 0.07 ^{ab}	2.4 ± 0.4 ^{ab}	7.2 ± 1.9 ^a	8.5 ± 0.1
30	2.7 ± 0.4 ^{ab}	1.9 ± 0.2 ^b	0.70 ± 0.12 ^{ab}	2.7 ± 0.5 ^a	4.3 ± 0.6 ^{abc}	7.2 ± 0.5
50	2.4 ± 0.1 ^{ab}	1.9 ± 0.1 ^b	0.85 ± 0.05 ^a	1.4 ± 0.1 ^{bc}	3.6 ± 0.3 ^{abc}	6.6 ± 0.3
70	2.1 ± 0.1 ^b	1.8 ± 0.1 ^b	0.49 ± 0.04 ^b	1.5 ± 0.2 ^{bc}	3.0 ± 0.2 ^{bc}	7.9 ± 1.7
80	2.1 ± 0.1 ^b	1.9 ± 0.1 ^b	0.51 ± 0.06 ^b	1.1 ± 0.1 ^c	2.3 ± 0.2 ^c	7.5 ± 1.2
90	2.2 ± 0.1 ^b	2.0 ± 0.1 ^b	0.50 ± 0.05 ^b	1.0 ± 0.1 ^c	1.9 ± 0.3 ^c	6.9 ± 1.1

Values are means ± SEM.

^{a,b,c}Means within a row with different superscripts are significantly different ($P < 0.05$).

of days from puberty. Samples from a prepubertal group were collected at least 19 days before puberty and not thereafter ($n = 9$).

All data were analysed using the Statistical Analysis System (SAS, 1985). In Expt 1, data were subjected to the general linear model analysis of variance. Main effects included in the model were age and litter. For corticosteroids, the effect of time (morning versus afternoon) and the interaction time × age were introduced in the model of analysis of variance. Bonferroni's tests (SAS, 1985) were used for comparisons between means. In Expt 2, all groups were compared with the prepubertal group using Student's *t* test.

Results

Puberty attainment

In Expt 1, none of the gilts had ovulated before collection of blood samples. In Expt 2, nine out of 15 females were pubertal before 130 days of age. Ovulation did not occur without a detected oestrus. The standing reaction in the presence of a boar was observed for 2–3 consecutive days. Age at puberty ranged between 99 and 116 days and averaged 111 ± 4 days (mean ± SEM). In three females, a standing response to the pressure on the back was observed 3–13 days before puberty but lasted only 1 day and was not accompanied by ovulation. In addition to the prepubertal group, there were five groups with different intervals between collection of blood samples and puberty: 11–13 days before ($n = 3$), 4–6 days before ($n = 4$), 1 day after ($n = 1$), 4–5 days after ($n = 4$), 11–15 days after the occurrence of puberty ($n = 4$).

LH profiles

In Expt 1, mean concentration of LH in plasma varied with age ($P < 0.01$); it was significantly higher at 1 than at 10, 20, 70, 80 and 90 days of age and was intermediate between 30 and 50 days of age (Table 2). Baseline LH values decreased significantly between 1 and 10 days of age and did not change thereafter (Table 2). Pulses were observed at every age but their frequency showed large variations ($P < 0.01$, Table 2).

Fig. 1. Schematic variation of LH pulsatility (---) and FSH concentration in Meishan gilts during sexual maturation (—). PN: Perinatal; I: infancy.

Frequency of pulses increased significantly from 0.42 pulse h⁻¹ at 10 days of age to 0.85 pulse h⁻¹ at 50 days of age (Table 2), declined between 50 and 70 days (0.49 ± 0.04 pulse h⁻¹) and remained low thereafter. The amplitude of the pulse was high until 30 days of age and decreased progressively until 80 days of age from 2.7 ± 0.5 ml⁻¹ to 1.1 ± 0.1 ml⁻¹ (Table 2; Fig. 1).

In Expt 2, number of pulses was slightly higher 11–13 days before puberty than in the prepubertal group ($P = 0.07$, Fig. 2). Mean and baseline concentrations were higher 4–6 days before and 4–5 days after puberty than in the prepubertal group (Figs 2 and 3). Amplitude of pulses decreased 4–6 days before and increased 11–15 days after puberty compared with the prepubertal group ($P < 0.05$).

FSH concentrations

In Expt 1, mean concentrations of plasma FSH varied with age ($P < 0.01$, Table 2). It was high until 20 days of age and

Fig. 2. Variation in mean concentration of (□) LH and (■) FSH in plasma of Meishan gilts around puberty. Number of gilts per stage is indicated at the bottom of bars. From days -13 to -4 and days 4 to 15, means were compared with the prepubertal stage (> -19 days from puberty) and ●, *, **: $P = 0.07$, $P < 0.05$ and $P < 0.01$, respectively.

Fig. 3. Characteristics of LH profiles (□ baseline concentration, ■ amplitude and ▨ frequency of pulses) in Meishan gilts around puberty. From days -13 to -4 and days 4 to 15, means were compared with the prepubertal stage (> -19 days from puberty) and ●, *, **: $P = 0.06$, $P < 0.05$ and $P < 0.01$, respectively.

decreased progressively between 20 and 80 days of age from $7.2 \pm 1.9 \text{ ng ml}^{-1}$ to $2.3 \pm 0.2 \text{ ng ml}^{-1}$ (Table 2). In Expt 2, concentration of FSH was higher 4–5 days after puberty than in the prepubertal group ($P < 0.01$, Fig. 2).

Oestradiol concentrations

In Expt 1, plasma concentration of oestradiol did not vary significantly with age even though large fluctuations were observed (Table 2). In Expt 2, a significant increase was observed 4–6 days before puberty in comparison with the prepubertal group (Fig. 4).

Corticosteroid concentrations

In Expt 1, there was no interaction between time and age ($P > 0.1$) for the concentration of plasma corticosteroids, which

Fig. 4. Variation in concentration of plasma (□) oestradiol and (■) progesterone in Meishan gilts around puberty. From days -13 to -4 and days 4 to 15, means were compared with the prepubertal stage (> -19 days from puberty) and *, ***: $P < 0.05$ and $P < 0.001$, respectively.

Table 3. Plasma profiles of corticosteroids in Meishan gilts from 1 to 90 days of age

Age group	Corticosteroid concentration (ng ml ⁻¹)		
	Morning	Afternoon	Mean
1	114 ± 24	53 ± 4	83 ± 13 ^a
10	41 ± 4	24 ± 4	33 ± 3 ^b
20	48 ± 11	20 ± 6	34 ± 8 ^b
30	60 ± 2	37 ± 10	49 ± 5 ^{ab}
50	61 ± 9	30 ± 11	45 ± 8 ^{ab}
70	51 ± 6	23 ± 4	37 ± 4 ^b
80	41 ± 7	29 ± 9	35 ± 10 ^b
90	70 ± 13	34 ± 8	52 ± 10 ^{ab}

Values are means ± SEM.
^{ab}Means within a row with different superscripts are significantly different ($P < 0.05$).

was higher in the morning than in the afternoon ($P < 0.01$, Table 3). The mean daily concentration decreased between 1 and 10 days of age from $83 \pm 13 \text{ ng ml}^{-1}$ to $30 \pm 4 \text{ ng ml}^{-1}$ ($P < 0.05$) and did not change significantly thereafter.

In Expt 2, there was a similar diurnal variation of the concentration of plasma corticosteroids ($P < 0.01$, Fig. 5). The concentration in the morning decreased from 4–6 days before to 4–5 days after puberty in comparison with the prepubertal group (Fig. 5).

Discussion

In the study reported here profiles of LH in plasma of Meishan gilts were characterized by a high baseline soon after birth, a low frequency of pulses at 10 days of age, a high frequency of pulses at about 50 days, and low amplitude and frequency of

Fig. 5. Variation in morning (□) and afternoon (■) concentrations of corticosteroids in Meishan gilts around puberty. Number of gilts per stage is indicated at the bottom of the bars. From days -13 to -4 and days 4-15, means were compared with the prepubertal stage (> -19 days from puberty) and * $P < 0.05$.

pulses between 80 and 90 days. This pattern of variation is similar to that observed in Large White gilts (Camous *et al.*, 1985) even though changes did not take place at the same age.

The observation of high concentrations of LH in plasma shortly after birth also agrees with results obtained in Landrace × Yorkshire piglets of both sexes (Colenbrander *et al.*, 1977). The present study shows that these high concentrations result from high baseline values rather than from high frequency of pulses. A similar period of high LH secretion around birth has been observed in calves (Challis *et al.*, 1974), guinea-pigs (Donovan *et al.*, 1975), humans (Kaplan and Grumbach, 1976) and rabbits (Berger *et al.*, 1982). A transient period of more frequent pulses during sexual maturation has been observed at later stages (80-120 days of age versus 20-50 days in the Meishan gilts of the present study) in gilts from European breeds attaining puberty at about 170 days (Diekman *et al.*, 1983) or at about 240 days (Camous *et al.*, 1985). In agreement with our previous results in Large White gilts (Camous *et al.*, 1985), the present study shows that the decrease in the frequency of LH pulses is accompanied by a progressive decrease of their amplitude.

In the last 2 weeks preceding puberty, three main phenomena were observed: an increase in LH and in oestradiol concentrations and a decrease in corticosteroid concentration. A higher pulsatility of LH occurred 11-13 days before puberty, whereas mean and baseline concentrations of LH were increased 4-6 days before puberty. A similar increase in pulsatility and/or in mean hormone concentration was observed during the last 2 weeks before puberty in European gilts by Andersson *et al.* (1983) and by Lutz *et al.* (1984), whereas Diekman *et al.* (1983) and Diekman and Hoagland (1983) did not observe any significant variation. The increase in baseline values observed in our experiment could reflect a true increase in basal secretion. Alternatively, it is possible that, with the decrease in the amplitude of pulses, their identification was more difficult resulting in an underestimation of pulsatility and overestimation of baseline value. A pattern of high frequency and low amplitude of LH pulses was observed in prepubertal gilts by Beltranena *et al.* (1993) and was associated with heavier reproductive tracts and a higher secretion of oestradiol than in gilts with more distinct,

less frequent, pulses. An increase in LH secretion before puberty has been clearly observed in humans (Boyar *et al.*, 1974; Parker *et al.*, 1975), in rats (Meijs-Roelofs *et al.*, 1983; Urbanski and Ojeda, 1985) and in sheep (Foster *et al.*, 1975; Foster and Ryan, 1981). Our experiments show that mean and baseline concentrations of LH were still higher during the early luteal phase (4-5 days after puberty) than during the prepubertal stage. At the end of the first luteal phase (11-15 days after puberty), LH secretion was characterized by a distinct pattern of high-amplitude, low-frequency pulses as already described in cyclic European or miniature Göttingen sows (Parvizi *et al.*, 1976; Van de Wiel *et al.*, 1981).

After a period of high concentrations, plasma FSH declined progressively between 20 and 80 days of age in our Meishan gilts. A similar decrease during sexual maturation has already been observed in gilts from European breeds (Rayford *et al.*, 1974; Diekman *et al.*, 1983; Camous *et al.*, 1985) and in other species, such as sheep (Foster *et al.*, 1975), rats (Döhler and Wuttke, 1975) and cattle (Schams *et al.*, 1981). No significant variations in the concentration of plasma FSH were observed during the last weeks preceding puberty in agreement with Diekman *et al.* (1983). During the early luteal phase, we observed a slight increase in plasma FSH; this is in agreement with results from European gilts during the first oestrous cycle (Ponzilius *et al.*, 1984) and subsequent cycles (Rayford *et al.*, 1974; Van de Wiel *et al.*, 1981).

Relatively high concentrations of oestradiol were observed shortly after birth; this is in agreement with observations in neonatal piglets from European breeds (Zieciak *et al.*, 1990). These oestrogens are probably fetal oestrogens of placental origin that have not yet been eliminated (Ponzilius *et al.*, 1986). The lack of variation in plasma oestradiol concentrations during sexual development up to 1 week before puberty agrees with results obtained in gilts from European breeds (Karlborn *et al.*, 1982; Lutz *et al.*, 1984). However, Schlenker *et al.* (1973) and Camous *et al.* (1985) did observe an increase in oestrogen excretion during sexual maturation. In Meishan gilts, the ovaries undergo a period of development between 30 and 60 days of age with the appearance of the first antral follicles and of follicles more than 1 mm diameter and their multiplication (Cheng, 1983; Prunier *et al.*, 1987; Miyano *et al.*, 1990). This phase of intense ovarian development coincides with that of high LH pulsatility as in gilts from European breeds (Camous *et al.*, 1985). We observed an increase in plasma concentrations of oestradiol 4-6 days before puberty, which probably indicates ovarian stimulation and the beginning of the first follicular phase. The increase in LH secretion observed 4-13 days before puberty was probably the origin of that stimulation.

The high concentration of plasma corticosteroids at birth, the subsequent decline and the lack of variation during the following weeks are comparable to the pattern found in European breeds of pig (Herbein *et al.*, 1977; Kattesh *et al.*, 1990). This perinatal peak is involved in the initiation of parturition (First and Bosc, 1979) and in the induction of hepatic gluconeogenic enzymes that play a role in the energy metabolism of the neonate (Martin *et al.*, 1973). The rapid postnatal decrease in corticosteroid concentrations may be due to changes in the metabolism or synthesis of cortisol in neonatal pigs. Our study shows a significant decrease between morning and afternoon values regardless of age; this reflects the circadian rhythm of

cortisol profiles. However, at 1 day of age, the decline between morning and afternoon could be simply due to the neonatal process of cortisol decrease. In young pigs from European breeds, it seems that there is no circadian variation at 28 days of age (Evans *et al.*, 1989), although circadian rhythms have been clearly observed in older animals (Whipp *et al.*, 1970; Bottoms *et al.*, 1972; Favre and Moatti, 1977; Evans *et al.*, 1989) but with age-related variations in the timing of peaks and troughs (Evans *et al.*, 1989). Whether the difference in age-related patterns of corticosteroid concentrations between Meishan and European pigs is a true effect of genotype or is a consequence of various environmental conditions remains to be elucidated. Our study shows that the concentration of plasma corticosteroids in the morning decreased shortly before puberty and remained relatively low during the early luteal phase. Few data are available concerning corticosteroid variations during the oestrous cycle. Observations from Esbenschade *et al.* (1982) did not show any difference between the follicular phase and the early luteal phase, in agreement with our results. The decrease in corticosteroid secretion at the onset of puberty needs further investigation. It could explain the increase in LH secretion since cortisol has been shown to inhibit LH secretion (Liptrap and Raeside, 1968; Pearce *et al.*, 1988; Estienne *et al.*, 1991). Moreover, a direct effect of cortisol on androgen secretion by thecal cells of the porcine ovary has been demonstrated *in vitro* (Raeside and Xun, 1986).

The results of our experiments show that four phases, corresponding to those already described in Large White gilts (Camous *et al.*, 1985) can be distinguished during sexual maturation of Meishan females: (i) a perinatal phase characterized by high baseline and low frequency of LH pulses and high FSH concentrations; (ii) an infancy period at about 10 days of age, during which pulsatility of LH is low while FSH concentrations are still high; (iii) a juvenile phase at about 50 days of age, during which, under stimulation due to higher LH pulsatility and the maintenance of high FSH concentrations, antral follicles appear and multiply in the ovaries and (iv) a waiting period between 80 and 90 days of age. Frequency and amplitude of LH pulses as well as FSH concentrations are low presumably owing to the ovarian negative feedback. Increases in LH pulsatility, and in mean and baseline concentrations observed during the 2 weeks before puberty probably stimulate follicular growth and oestradiol secretion leading to the first follicular phase. The decrease in corticosteroids during the last week before puberty may contribute to pituitary or ovarian stimulation or to both. Thus, sexual maturation follows the same pattern in gilts with very different sexual precocity. However, duration of the various phases is shorter in the Meishan breed than in European breeds. The waiting period is particularly variable and is sometimes absent.

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