SHORT COMMUNICATIONS

Effects of an opioid antagonist (naloxone) on reproductive function of multiparous sows

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MANY factors are involved in the recovery of ovarian activity in sows after weaning and in the interval from weaning to oestrus, such as season of the year, nutrition, duration of lactation or litter size (Varley 1982, Foxcroft and others 1992). Concerning the latter, the interval from weaning to oestrus is negatively correlated with the number of piglets nursed (Stevenson and Britt 1981) and luteinising hormone (LH) is higher during lactation in sows nursing small litters than in those nursing normal litters (Kunavongkrit 1984).

Different studies dealing with opiate agonists and antagonists have demonstrated that, in most domestic animals, endogenous opioid peptides inhibit LH and stimulate prolactin (PRL) (Almeida and others 1988, Cosgrove and others 1993). Administration of naloxone, an opioid antagonist, during lactation has been proven to increase LH (Armstrong and others 1986) and to reduce serum PRL in sows (De Rensis and others 1998a). In pregnant gilts, naloxone increases LH (Szafranska and others 1994) and reduces PRL (Szafranska and Tilton 1995) at day 40 of pregnancy; however, at day 70, LH and PRL concentrations have been shown to be similar before and after treatment. Other studies (Prunier 1992) have confirmed that naloxone inhibits LH in gilts, suggesting that modulation of LH secretion by opioids varies during sexual maturation: it is inhibitory in neonatal females and is stimulatory in adult females.

The aim of the present study was to test the hypothesis that an opiate antagonist could improve 'reproductive efficiency' through administration of naloxone during the last days of lactation, in two different lactation periods (21 and 28 days). Certain hormonal parameters, that is, progesterone, cortisol and 17β -oestradiol, were investigated, and changes in their serum concentrations after administration of naloxone were determined.

The study was carried out on a farm with a capacity of 500 productive sows (Landrace x Large White) that were examined for standing oestrus twice a day (in the morning and in the afternoon) and were mated naturally. Pregnancy diagnosis was made using B mode real time ultrasonography at 25 or 30 days. After mating, the sows were penned in individual crates throughout the gestation period. They were fed 2 to 2.2 kg of commercial food once a day, up to 30 days before parturition. After that, their ration was increased to 3 kg/sow/day. In the last four or five days of gestation, the diet was reduced. During lactation and after weaning, the sows were allowed to eat and drink ad libitum.

A total of 72 multiparous crossbred sows were used in this experiment. Litter sizes were standardised (eight piglets) within 48 hours of parturition, and sows and piglets were penned in individual crates throughout lactation. Thirty-six sows (18 whose piglets were weaned at 21 days and 18 whose piglets were weaned at 28 days) were injected, intramuscularly, with naloxone (Sigma Chemicals) in saline solution (200 mg/sow/day), equivalent to 1 mg naloxone/kg liveweight, in two doses per day (at 08.00 and 20.00) during three consecutive days before weaning, and on the day of weaning. The remaining 36 sows (18 whose piglets were weaned at 21 days and 18 whose piglets were weaned at 28

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TABLE 1: Number of sows eliminated due to anoestrus, recurrence of heat (RH), negative diagnosis of gestation (NDG), 'not in pig' sows (NIP), and total of elimination (TE) in the control and naloxone-treated groups

	Lactation			
	21 days		28 days	
	Control (n=18)	Treated (n=18)	Control (n=18)	Treated (n=18)
Anoestrus	1	0	1	0
RH	1	1	0	1
NDG	2	1	3	2
NIP	0	0	1	0
TE	4	2	5	3

days) were kept as controls and injected with a saline solution.

The following parameters were evaluated: the interval from weaning to the first fertile oestrus after weaning (WFHI); the number of liveborn piglets (ABP) and number of stillborn piglets (SBP) at the subsequent farrowing after the experiment and, finally, the rate of culling due to reproductive failures: anoestrus, repeat service (RS), negative pregnancy diagnosis (NGD), sows 'not in pig' (NIP).

Serum concentrations of progesterone, 17 β -oestradiol and cortisol were measured by radioimmunoassay using commercial kits (ICN Biomedicals) with coated tube techniques. For progesterone, the sensitivity of the assay was 0.1 ng/ml whereas for cortisol and 17 β -oestradiol the sensitivities were 0.5 ng/dl and 5 pg/ml, respectively. These parameters were evaluated in 10 sows from each group (treated and controls), five weaning at 21 days and five at 28 days. A total of seven blood samples were taken from the caudal vein from each sow, on day -3, day -2 and day -1 before weaning, on the day of weaning (day 0) (two hours after the administration of naloxone) and on days 1, 2 and 3 after weaning. All the data were analysed by least square techniques using the general linear models procedure of SAS (6.03 release, SAS Institute). Means were compared using Student's *t* test.

The reproductive results are shown in Tables 1 and 2. The number of sows eliminated, and whose piglets were weaned either at 21 or 28 days, was significantly ($P<0.05$) lower in the group treated with naloxone, as well as the interval to first fertile oestrus, for both lactation periods (21 and 28 days). Likewise the litter size at farrowing increased in groups treated with naloxone; the number of liveborn piglets increased ($P<0.05$) and the number of stillborn piglets decreased ($P<0.05$).

The concentration of 17 β -oestradiol varied considerably among sows in the control and experimental groups. A relationship between concentrations of this hormone and both the lactation period ($P<0.01$) (the concentration was higher over a lactation period of 21 days) and the day of sampling ($P<0.05$) was observed. No modification associated with the treatment was found. In all the samples, the levels of progesterone found in the experiment were lower than 1 ng/ml and correlation between its concentrations and the treatment were observed ($P<0.01$) with a decrease in the levels after administration of naloxone. Treatment with naloxone reduced cortisol secretion ($P<0.001$) in both lactation periods. Changes in the level of this hormone due to either the lactation period or the day of sampling were not observed.

The reduction in the number of sows culled due to reproductive problems, and the reduction of the interval between weaning and the first fertile oestrus observed in this study, suggest a return of the cyclical ovarian function earlier in the sows treated with naloxone than in the control group. The possible recovery of the ovarian function could be due to an increase in LH and a decrease in PRL concentrations in serum, as has been previously reported to occur in sows treated with

TABLE 2: Least square means (se) of dependent variables (reproductive traits) by treatment and length of lactation for the control and naloxone-treated groups

	Lactation			
	21 days		28 days	
	Control	Treated	Control	Treated
WFHI	11.2 (2.44)	7.75 (1.59)	7.78 (1.96)	6.70 (0.95)
ABP	10.1 (0.64)	11.7 (0.71)	10.5 (0.59)	11.5 (1.09)
SBP	0.93 (0.43)	0.50 (0.23)	1.07 (0.43)	0.20 (0.13)

WFHI Interval from weaning to first fertile oestrus after weaning, ABP Number of liveborn piglets, SBP Number of stillborn piglets

naloxone (Armstrong and others 1986, 1988, De Rensis and others 1994), although these hormones have not been evaluated in this work. The increase in prolificity observed could be a consequence of either an increase in the ovulation rate, or an earlier endometrial regeneration induced by the treatment with naloxone.

Variations in 17 β -oestradiol concentrations might be related to the sources of oestrogens during lactation. They could originate from the adrenal cortex, and stress is the factor involved in their synthesis and release (Kunavongkrit 1984). The absence of a relationship between oestrogen secretion and prolonged weaning-to-oestrus intervals is in agreement with previous experiments (Varley and Foxcroft 1990). The decrease in progesterone values, noticed after the administration of naloxone in this study, has not been observed before in other similar studies on pregnant gilts (Szafranska and others 1994, Szafranska and Tilton 1995). It is known that sucking stimulates the release of β -endorphin and adrenocorticotrophic hormone (ACTH), and plasma levels of β -endorphin increase as a result of stressful procedures in animals (De Rensis and others 1998b). A stimulus as potent as sucking would increase the production of opiate and cortisol, and would block LH secretion (Almeida and others 1988). Administration of naloxone would reduce the levels of β -endorphin and cortisol (Foxcroft and others 1992). Moreover, the reduction in the interval from weaning to first fertile oestrus, observed in this study, could be related to the effects of ACTH and cortisol on follicular development. Indirect evidence suggests that ACTH and adrenal corticoids may affect follicular development through an effect on the secretion of LH (Britt and others 1985). The reduction in cortisol observed in this present study could have produced an increase in the follicular growth and recovery of ovarian function.

Evidence obtained from this study suggests that the administration of naloxone before weaning may improve both the recovery of ovarian function after weaning and the productivity of the farm.

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TABLE 1: Total nematode eggs shedding in samples collected from the soil (H value) versus samples collected from the rectum (I value). Values are expressed as arithmetic mean (sd) egg count

Species	Herd	Number in herd	H value	I value	P
<i>Gazella cuvieri</i>	1	7	621.4 (30.2)	653.9 (818.5)	0.77
	2	12	650.6 (41.6)	813.1 (632.4)	0.71
	3	4	210.0 (14.1)	580.4 (357.7)	0.35
Total		23			
<i>Gazella dorcas neglecta</i>	4	7	29.9 (14.0)	13.4 (35.3)	0.82
	5	10	10.0 (14.1)	82.9 (79.9)	0.37
	6	7	0	54.5 (80.0)	0.30
	7	6	49.8 (14.0)	32.5 (50.4)	0.48
	8	11	0	232.9 (377.2)	0.15
	9	8	49.8 (13.9)	76.1 (119.4)	0.80
Total		49			
<i>Gazella dama mhorr</i>	10	4	59.9 (28.2)	72.8 (108.9)	0.64
	11	6	30.1 (42.6)	126.6 (126.6)	0.50
	12	4	50.0 (14.1)	105.6 (111.2)	1.00
	13	8	10.0 (14.1)	18.7 (17.1)	0.34
Total		22			

be possible. Most zoological institutions perceive parasite control to be an important aspect of the husbandry of wild ruminants. These control programmes require an initial faecal sample collection, the employment of wide spectrum anthelmintics, and the subsequent evaluation of the effectiveness of the treatment (Isaza and others 1990, Abaigar and others 1995).

Individual animal faecal samples for parasitological surveys may be obtained directly from the rectum or from the ground if it can be proved to come from an identified animal. Both procedures are quite impractical for herd sampling due to the risk of trauma and stress to restrained animals and the long tracking time needed, respectively. The aim of this study was to evaluate the reliability of an alternative method for estimating nematode eggs elimination in wild ruminants, such as sampling on a herd basis and collecting faeces from the ground of the herd enclosure, thus avoiding the previous problems.

Ninety-four gazelles (23 *Gazella cuvieri*, 49 *Gazella dorcas neglecta*, and 22 *Gazella dama mhorr*) divided into 13 herds of four to 12 individuals (Table 1) were sampled. The evening before sampling, all faeces from the ground of each enclosure were removed. Line transects were done to assure the study of the whole surface of the enclosure. Sampling was carried out early in the morning, and 1.5 to 2.0 g of faeces were collected from each group of fresh excrements. Considering that there were four to 12 animals in each herd, and that there were approximately two groups of faeces per animal at this point in time, 14 to 42 g of excrements were collected per herd. The faeces were pooled in labelled plastic bags, carefully mixed, and preserved at 4°C until analysed. Additionally, all individuals were captured and faeces were collected directly from the rectum, and stored as before.

Analyses were performed by the flotation method using Sheather's sugar solution (Sheather 1923), and the faecal egg count was determined using the modified McMaster's technique (Davies 1990). Egg counts of *Nematodirus* species, other trichostrongyles and *Trichuris* species were performed separately. The values for trichostrongyles are the results of the addition of the corresponding records of *Nematodirus* and other trichostrongyles. In the same way, total egg counts were the sum of all the nematode eggs counted. Two different values of eggs shedding were recorded for each herd: herd values (H, that is, the average values of faeces collected from the ground), and individual values (I, that is, the average values of individual samples).

To assess the efficacy of the ground sampling method, both H and I values were compared using the Mann-Whitney

Use of pooled faecal samples in assessing nematode egg shedding in captive gazelles (*Gazella* species)

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MANAGEMENT of wild animals in captivity is always complicated. Data collection (such as biometry and ear-tag marks), clinical manipulation and vaccination require individual immobilisation, with the subsequent distress and risk of traumatic injury. Indeed, traumatic injuries are one of the most important causes of clinical diseases, and even mortality, in gazelles, especially nervous species such as *Gazella dorcas* (Espeso and others 1995).

Gastrointestinal parasites are another significant cause of disease in wild ruminant populations. Previous studies carried out in the Parque de Rescate de la Fauna Sahariana, CSIC, Almería, Spain, revealed the coexistence of a gastrointestinal nematode population comprising *Camelostrongylus mentulatus*, *Nematodirus spathiger*, *Trichostrongylus vitrinus*, *Trichostrongylus probolurus*, *Ostertagia ostertagi*, *Trichuris ovis*, *Trichuris globulosa* and *Oesophagostomum venulosum* (Ortiz and others 1998). Low burdens of these parasites did not lead to severe disturbances in wild populations. However, the condition of captivity increases the risk of reinfestations, and so the appearance of clinical digestive pathologies could

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