January 2000

The Effect of Oxytocin at the Time of Insemination on Reproductive Performance — A Review

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Summary and Implications

Oxytocin is released from the brain of the sow at the time of mating in response to stimulation by the boar. It is assumed that it enhances sperm transport to the oviduct. Several investigators have studied whether injecting oxytocin into semen before artificial insemination improves farrowing rate and litter size. The conclusions from review of these studies are: 1) Adding 4 to 5 IU's of oxytocin to a dose of semen improves farrowing rate and litter size; 2) Use of oxytocin-treated semen is more effective in multiparous sows than gilts; 3) During the summer months, oxytocin-treated semen significantly increased farrowing rate and litter size; and 4) In most studies, the use of oxytocin at the time of insemination was profitable. Oxytocin should be added to the semen with an insulin syringe immediately before attaching the semen vessel to the insemination catheter.

Introduction

Although billions of spermatozoa are deposited in the cervix of the female pig during the process of artificial insemination, only thousands of sperm are found in the oviduct. Sperm cells are transported to the oviduct within 15 minutes to 2 hours after deposition in the cervix. To prevent them from being phagocytized (killed) by leukocytes, it is extremely important that sperm cells arrive in the oviduct as quickly as possible. Fertilization of ova occurs at the ampulla-isthmus junction of the oviduct.

Oxytocin concentration in the blood of sows increases dramatically within 2 minutes of the onset of ejaculation by a mature boar. In addition, the plasma concentration of oxytocin starts to increase when the nose of a sow is sprayed for two seconds with a synthetic boar pheromone (Sex Odor Aerosal, 5a-androst-16-en-3-one). This short-term increase of oxytocin supports the rapid sperm transport mechanisms immediately after mating. Several investigators have studied whether farrowing rate and litter size are enhanced by adding: (1) oxytocin or an oxytocin analogue to a dose of semen just before insemination, or (2) by injecting oxytocin into the muscle or vulva 2 to 5 minutes before insemination.

Toxicity of Oxytocin

Before adding oxytocin to semen, it is extremely important to know whether it has detrimental effects on spermatozoa. A study in Czechoslovakia evaluated the effect of adding various concentrations of oxytocin or an oxytocin analogue (Depotocin) on sperm motility over a duration of four hours (Table 1). When .25, .50 or 1.0 International Units (IU) of oxytocin or .50, 1.0, or 2.0 IU of Depotocin was added to 8 mL of semen, estimated motility of sperm cells was not different from the control sample after 60 minutes of storage. Detrimental effects on sperm motility occurred in samples containing .125 IU or greater of oxytocin per mL at 120 minutes after adding oxytocin. The study did

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Table 1. The influence of oxytocin and Depotocin (oxytocin analogue) on motility of spermatozoa during storage.

		Oxytocin, mL			Depotocin, mL			Control
		.05	.10	.20	.05	.10	.20	
Volume of semen, mL		8	8	8	8	8	8	8
IU of oxytocin		.25	.50	1.0	.50	1.0	2.0	0
IU of oxytocin/mL of semen		.0313	.0625	.1250	.0625	.1250	.2500	0
Number of ejaculates	Duration of time after adding oxytocin, minutes	Progressive motility of spermatozoa, %						
12	60	75 (60 to 80)[a]	74 (60 to 80)	70 (60 to 80)	73 (60 to 80)	73 (60 to 80)	72 (60 to 80)	75 (60 to 80)
12	120	64 (60 to 80)	73 (60 to 80)	59 (50 to 70)	75 (60 to 80)	71 (50 to 80)	61 (50 to 70)	74 (60 to 80)
12	180	73 (50 to 80)	70 (50 to 80)	55 (50 to 70)	73 (60 to 80)	69 (50 to 80)	56 (40 to 70)	73 (60 to 80)
12	240	74 (60 to 80)	69 (50 to 80)	48 (20 to 70)	72 (60 to 80)	67 (50 to 70)	39 (30 to 60)	71 (60 to 80)

[a]Range in estimate of sperm motility.
Reference: Biologizac a Chemizace Zivocisne Vyroby-Veterinaria 20(2):181-191, 1984.

not evaluate the effect of oxytocin in the semen on farrowing rate or litter size.

International Units of Oxytocin per Dose of Semen

A scientific study that evaluated an equally spaced range of IU's of oxytocin in semen on farrowing rate and litter size was not found. In most studies, 4, 5 or 10 IU of oxytocin per dose of semen (100 mL) were added immediately before attaching the semen vessel to the AI catheter. Table 2 has results of four such studies. In Study 1, the addition of 4 IU of oxytocin to a dose of semen immediately before insemination produced a numerically greater farrowing rate, number of pigs born live and fecundity index (FI) compared to control sows. In the three studies that used 5 IU of oxytocin, Studies 2 and 3 showed a small numeric increase in farrowing rate and FI for sows inseminated with semen containing 5 IU oxytocin compared to control sows. However, Study 4 found a 5.8 percent decrease in farrowing rate and a 14 pig decrease in FI for sows inseminated with oxytocin-treated semen compared to control sows. Although the addition of 10 IU of oxytocin to semen in Study 4 showed a small beneficial effect on average number of pigs born live per litter compared to control sows, the farrowing rate of sows inseminated with oxytocin-treated semen was reduced by 8.1 percent and the FI was reduced by 64 pigs. These studies did not partition the data to determine whether oxytocin-treated semen produced the same results in all parities.

Table 2. Influence of oxytocin-treated semen on reproductive performance.

	International Units (IU) of Oxytocin added to semen at time of insemination				Difference		
	Control (C)	4 IU	5 IU	10 IU	C - 4 IU	C - 5 IU	C - 10 IU
Study 1: Proc. 11th International Congress Anim. Reprod. & AI, Vol 3, pp 239-240, 1988.							
# Sows	35	36	—	—	-1	—	—
FR, %[a]	88.6	94.4	—	—	-5.8	—	—
# BA[b]	9.39	10.21	—	—	-.82	—	—
FI[c]	832	964	—	—	-132	—	—
Study 2: Anim. Breed. Abstracts 52(11); Abstract No. 6718, 1984.							
# Sows	211	—	176	—	—	35	—
FR, %	77.2	—	78.4	—	—	-1.2	—
# BA	9.19	—	9.23	—	—	-.04	—
FI	709	—	724	—	—	-15	—
Study 3: Anim. Breed. Abstracts 53(6); Abstract No. 3776, 1985.							
# Sows	494	—	405	—	—	89	—
FR, %	81.0	—	84.0	—	—	-3.0	—
# BA	10.4	—	10.2	—	—	.2	—
FI	842	—	857	—	—	-15	—
Study 4: Anim. Breed. Abstracts 53(12); Abstract No. 7740, 1985.							
# Sows	99	—	100	98	—	-1	1
FR, %	92.8	—	87.0	84.7	—	5.8	8.1
# BA	9.9	—	10.4	10.1	—	-.5	-.2
FI	919	—	905	855	—	14	64

[a]Farrowing rate of sows bred.
[b]Average number of piglets born live per litter.
[c]Fecundity index per 100 sows (farrowing rate x number of pigs born live).

Effect of Parity

Table 3 contains the results of oxytocin-treated semen on reproductive performance of gilts and sows. In

Table 3. The influence of oxytocin-treated semen on reproductive performance of gilts and multiparous sows.

Item	Oxytocin[a] (O)	Control (C)	Difference (C - O)
Study 1: Archiv fur Experimentelle Veterinarmedizin 31(4):561-566, 1977			
Gilts			
Number of females	315	296	-19
Farrowing rate, %	80.6*	74.3	-6.3
Total piglets/ litter	9.07	9.10	.03
Live piglets/litter	8.00	7.96	-.04
Fecundity index	645	591	-54
Multiparous			
Number of females	377	385	8
Farrowing rate, %	88.6	89.4	.8
Total piglets/ litter	11.25	11.25	0
Live piglets/litter	10.12	9.98	-.14
Fecundity index	897	892	-5
Study 2: Zivocisna Vyroba 33(9):845-850, 1988			
Gilts			
Number of females	342	606	264
Farrowing rate, %	67.8	69.6	1.8
Piglets born per litter	8.3	8.4	.1
Fecundity index	563	585	22
Multiparous			
Number of females	1418	587	-831
Farrowing rate, %	79.8*	75.6	-4.2
Piglets born per litter	9.9*	9.7	-.2
Fecundity index	790	733	-57

[a]5 IU of oxytocin added to semen at time of insemination.
*Means are significantly different (P < .05) between treatments.

Study 1, farrowing rate was significantly (P < .05) increased in gilts inseminated with oxytocin-treated semen compared to control gilts. However, farrowing rate of multiparous sows was not different between sows inseminated with oxytocin-treated semen and control sows. In Study 2, the addition of 5 IU of oxytocin to the semen just before inseminating gilts did not improve their farrowing rate or number of piglets. However, farrowing rate and number of piglets born per litter were significantly (P < .05) improved in multiparous sows inseminated with oxytocin-treated semen compared to control sows.

A Czechoslovakian study evaluated the influence of adding 5 IU of oxytocin in the semen immediately before insemination on farrowing rate and litter size by parity (Table 4). The addition of oxytocin to semen inseminated into gilts did not improve farrowing rate, total number of pigs born per litter, number of pigs born live per litter, or FI. Except for 3rd parity sows, the addition of oxytocin to semen had

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Table 4. Influence of oxytocin-treated semen on farrowing rate and litter size by parity.

	Farrowing rate, %			Average number of piglets born per litter						Fecundity index[d]	
				Total born			Live born				
Parity	Oxytocin[a] (O)	Control (C)	C - O	Oxytocin	Control	C - O	Oxytocin	Control	C - O	Oxytocin	Control
1 (Gilts)	68.78 (157)[b]	69.52 (105)[b]	.74	7.63 (108)[c]	7.63 (73)[c]	0	7.08	7.20	.12	487	501
2	76.19 (105)	75.90 (83)	-.29	8.72 (80)	8.71 (63)	-.01	8.13	8.11	-.02	619	616
3	77.08 (96)	77.21 (79)	.13	8.77 (74)	8.62 (61)	-.15	8.37	7.98	-.39	645	616
4	75.49 (102)	72.88 (59)	-2.6	9.09 (77)	8.83 (43)	-.26	8.38	8.13	-.25	633	593
5	81.52 (92)	80.85 (47)	-.67	9.74 (75)	9.47 (38)	-.27	9.08	8.65	-.43	740	699
6	86.11 (72)	75.00 (40)	-11.11	10.27 (62.)	9.53 (30)	-.74	9.53	8.33	-1.2	821	625
7+	84.84 (99)	76.00 (30)	-8.84	10.52 (84)	10.56 (23)	.04	9.42	8.82	-.60	799	670
2 to 7+	79.85 (566)	76.33 (338)	-3.52	9.50 (452)	9.08 (258)	-.42	8.79	8.25	-.54	702	630
Total	77.45 (723)	74.71 (443)	-2.74	9.13 (560)	8.76 (331)	-.37	8.45	8.02	-.43	654	599

[a]5 IU of oxytocin sofa was added to the extended semen at time of insemination.
[b]Number of females inseminated.
[c]Number of females farrowed.
[d]Number of pigs per 100 sows (farrowing rate x litter size born live).
Reference: Veterinarstvi 28(9):395-397, 1978.

a positive effect on farrowing rate of multiparous sows. The largest effect of oxytocin on farrowing rate occurred for sows in their 6th or greater parity. The addition of 5 IU of oxytocin to semen had a positive effect on number of piglets born live per litter for sows in their 2nd or greater parity. Because of the positive effect on number of piglets born live per litter for sows inseminated with semen containing oxytocin, the FI was numerically greater for Parity 2 or greater.

In a trial involving 17,755 sows and gilts at 21 breeding stations in Germany, the addition of 4 to 5 IU of oxytocin to the semen just before insemination did not significantly increase farrowing rate or litter size (Table 5). However, when the data set was partitioned into gilts, primiparous and multiparous females, the average number of piglets born live was significantly ($P < .05$) greater in multiparous sows inseminated with oxytocin-treated semen compared to control sows. When the data set only included industrialized pig farms, females inseminated with oxytocin-treated semen had a small increase in farrowing rate compared to control sows (Table 6). Although gilts inseminated with oxytocin-treated semen had a .03 pig decrease in average number of piglets born per litter compared to control sows, they had an FI advantage of 14 pigs because of a 1.8 percent increase in farrowing rate. Parity 2 sows inseminated with oxytocin-treated semen had a small advantage for average number of pigs born live per litter and FI. Parity 3 and greater sows inseminated with oxytocin-treated semen had .24 more pigs born live per litter and a 28 pig advantage for FI compared to control sows.

Table 5. Effect of oxytocin-treated semen on reproductive performance of gilts, primiparous and multiparous sows.

Item	Control	Oxytocin	Control - Oxytocin
All females on the experiment			
Number of females	8721	9034	-313
Farrowing rate, %	78.1	78.2	-.1
Avg pigs born/litter	10.70 ± 3.23	10.80 ± 3.23	-.10
Avg pigs born live	10.18 ± 3.09	10.28 ± 3.08	-.10
Fecundity index	795	804	-9
Gilts			
Number of gilts	2,663	2,903	-240
Farrowing rate, %	73.8	72.5	1.3
Avg pigs born/litter	9.60 ± 3.12	9.19 ± 2.98	.41
Avg pigs born live	9.11 ± 3.04	9.07 ± 3.07	.04
Fecundity index	672	658	14
Primiparous			
Number of sows	1,819	1,831	-12
Farrowing rate, %	76.7	78.6	-1.9
Avg pigs born/litter	10.90 ± 3.2	10.80 ± 3.23	0.1
Avg pigs born live	10.37 ± 3.06	10.36 ± 3.11	.01
Fecundity index	795	814	-19
Multiparous			
Number of sows	4,239	4,300	-61
Farrowing rate, %	81.3	82.0	-.7
Avg pigs born/litter	11.30 ± 3.13	11.50 ± 3.13	-.2
Avg pigs born live	10.71 ± 2.97	10.88 ± 2.96[a]	-.17
Fecundity index	871	892	-21

[a]Sow inseminated with oxytocin in semen had a significant ($P < .05$) increase in number of pigs born live per litter.

Reference: Monatshefte fur Veterinarmedizin 41(23):807-810, 1986.

Table 6. Influence of oxytocin on farrowing rate and litter size by parity for industrialized pig farms in Germany.

	Farrowing rate, %			Number of piglets born live per litter (mean ± SD)			Fecundity index		
Parity	Oxytocin[a](O)	Control (C)	C - O	Oxytocin	Control	C - O	Oxytocin	Control	C - O
1	69.6 (1342)[b]	67.8 (1467)[b]	-1.8	9.14 ± 3.02	9.17 ± 3.00	.03	636	622	-14
2	75.5 (1051)	74.4 (1026)	-1.1	10.15 ± 3.21	10.07 ± 3.27	-.08	766	749	-17
3+	81.7 (2279)	80.9 (2202)	-.08	10.83 ± 2.99	10.59 ± 3.10	-.24	885	857	-28

[a]4 to 5 IU Oxytocin-Spofa added to semen at time of insemination.

[b]Number of females inseminated.

Reference: Monatshefte fur Veterinarmedizin 41(23):807-810, 1986.

Effect of Oxytocin Analogue

An analogue of oxytocin is a synthetic product that generally has a longer duration of action than natural oxytocin. A comparison between 5 IU of oxytocin and 5 IU of Depotocin (oxytocin analogue) on farrowing rate and litter size by parity is shown in Table 7. In gilts and Parity 2 females, there was no significant difference in farrowing rate between females inseminated with semen containing oxytocin or Depotocin. In Parity 3 and greater females a significant ($P < .02$) increase of 10.3 percentage points in farrowing rate was found for sows inseminated with oxytocin-treated semen compared to sows inseminated with Depotocin-treated semen.

The average number of piglets

Table 7. Influence of oxytocin and Depotocin (oxytocin analogue) on farrowing rate and litter size by parity.

	Farrowing rate, %			Difference (Statistical significance of χ^2)		
Parity	Oxytocin (O)[a]	Depotocin (D)[b]	Control (C)	C - O	C - D	O - D
1 (gilts)	83.93 (56)[c]	85.48 (62)	85.29 (34)	1.36 (NS)[d]	-0.19 (NS)	-1.55 (NS)
2	89.36 (47)	88.68 (53)	90.77 (65)	1.41 (NS)	2.09 (NS)	0.68 (NS)
3+	79.88 (169)	90.20 (102)	70.31 (128)	-9.57 (NS)	-19.89 (.001)	-10.32 (.02)
Total	82.35 (272)	88.48 (217)	78.41 (227)	-3.94 (NS)	-10.07 (.01)	-6.13 (.10)
Parity	Number of piglets born live per litter (mean ± SEM)			Difference (Statistical significance of F-test)		
1 (gilts)	6.83 ± .37 (46)[c]	9.00 ± .17 (49)	7.92 ± .43 (29)	1.09 (NS)[d]	-1.08 (NS)	-2.17 (.05)
2	10.00 ± .12 (42)	9.00 ± .20 (47)	9.17 ± .21 (59)	-0.83 (.05)	0.17 (.05)	1.00 (.05)
3+	9.06 ± .13 (134)	9.06 ± .17 (102)	8.19 ± .22 (90)	-0.87 (.05)	-0.87 (.10)	0.00 (NS)
Total	8.38 ± .12 (223)	9.03 ± .14 (198)	8.43 ± .15 (178)	-0.05 (NS)	-0.60 (NS)	-0.65 (NS)

[a]5 IU (1 mL) of oxytocin was added to 80 mL of semen at time of insemination.
[b]5 IU (.5 mL) of Depotocin was added to 80 mL of semen at time of insemination.
[c]Number of sows bred.
[d]Nonsignificant difference.
Reference: Biologizac a Chemizace Zivocisne Vyroby-Veterinaria 20(2):181-191, 1984.

Table 8. Influence of oxytocin and Depotocin (oxytocin analogue) on farrowing rate and litter size by parity.

	Fecundity index[a]			Difference between treatments		
Parity	Oxytocin (O)[a]	Depotocin (D)[b]	Control (C)	C - O	C - D	O - D
1 (gilts)	573	769	675	102	-94	-196
2	894	798	832	-62	34	96
3+	724	817	576	-148	-241	-93
Total	690	799	661	-29	-138	-109

[a]Fecundity index (farrowing rate x litter born live) is calculated from the data in Table 7.
[b]5 IU (1 mL) of oxytocin was added to 80 mL of semen at time of insemination.
[c]5 IU (.5 mL) of Depotocin was added to 80 mL of semen at time of insemination.
Reference: Biologizac a Chemizace Zivocisne Vyroby-Veterinaria 20(2):181-191, 1984.

Table 9. Effect of oxytocin on farrowing rate and litter size born live of sows bred artificially by experienced and inexperienced technicians.

Item	Inexperienced technicians[a]	Experienced technicians	Main effect of treatments
Farrowing rate, %			
Control	78.1[c] (78)	87.2[d] (172)	85..3[e]
Oxytocin[b]	90.2[d] (84)	92.2[d] (166)	92.4[f]
Difference	12.1	5.0	7.1
Average number piglets born live			
Control	9.4[c] (78)	10.1[d] (172)	9.9[e]
Oxytocin	10.2[d] (84)	10.5[d] (166)	10.4[f]
Difference	.8	.4	.5

[a]Inexperienced technicians had performed less than 25 artificial matings at the beginning of the experiment.
[b]Intramuscular injection of 5 IU of oxytocin 2 to 5 minutes before artificial insemination
[cd,ef]Values with different superscripts in the same column and reproductive trait are different.
([cd]P < .05; [ef] P < .1)
Reference: North Carolina State University Annual Swine Report, pp 89-90, 1995.

born live per litter was significantly different (P < .05) between gilts inseminated with oxytocin-treated semen (6.83 piglets) and Depotocin-treated semen (9.00). In Parity 2 females, sows inseminated with oxytocin-treated semen had a significant increase (P < .05) in average number of piglets born live per litter compared to sows inseminated with Depotocin-treated semen (10.0 vs 9.0). The average number of piglets born live per litter was not different between Parity 3 and greater sows inseminated with oxytocin-treated or Depotocin-treated semen.

The FI was 196 pigs less for gilts inseminated with oxytocin-treated semen compared to gilts inseminated with Depotocin-treated semen (Table 8). In Parity 2 females, the FI was 96 pigs greater for sows inseminated with oxytocin-treated semen compared to Depotocin-treated semen (894 vs 798). In Parity 3 females, the FI was 93 pigs less for sows inseminated with oxytocin-treated semen compared to sows inseminated with Depotocin-treated semen. When all parities are combined within treatment, females inseminated with oxytocin-treated semen had 109 less pigs per 100 sows compared to females inseminated with Depotocin-treated semen.

Effect of Technician

A study conducted by North Carolina State University evaluated the effect of injecting 5 IU of oxytocin intramuscularly at 2 to 5 minutes before AI on farrowing rate and litter size (Table 9). Farrowing rate was increased by 12.1 percent (P < .05) and litter size born live by .8 pigs (P < .05) when inexperienced people injected oxytocin before inseminating females compared to inexperienced people not injecting oxytocin. Although not significantly different, the farrowing rate and average number of pigs born live per litter was greater when experienced people injected oxytocin as compared to experienced people not injecting oxytocin.

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Age of Sperm Cells

Significant improvements ($P < .05$) have been found in farrowing rate and litter size when 5 IU of oxytocin is injected into the muscle at 2 to 5 minutes before insemination when using sperm cells stored in Beltsville Thawing Solution for more than 72 hours (Table 10). Farrowing rate was improved by 17 percent and litter size by .07 piglets. The average motility score of the sperm cells was 45.7 $\pm$ 5.8%.

Method of Using Oxytocin

An experiment in Spain studied the effect of adding 4 IU of oxytocin (Oxyvet®) to 100 mL of extended semen just before insemination or injecting 4 IU of oxytocin in the mucosa of the vulvar lips just before insemination on farrowing rate and total litter size born (Table 11). Farrowing rate and litter size were not significantly different when sows were inseminated with oxytocin-treated semen or injected with oxytocin in the vulva. However, the overall farrowing rate was 5.7 percent greater for sows inseminated with oxytocin-treated semen compared to sows injected with oxytocin immediately before insemination. The overall litter size was 11.50 pigs for sows inseminated with oxytocin-treated semen and 10.97 pigs for sows injected with oxytocin at the time of insemination.

Influence of Season

The addition of 4 IU of oxytocin to semen just before insemination resulted in a significant ($P < .05$) increase in farrowing rate for sows inseminated during the summer months (Table 11). Farrowing rate was not significantly increased during the summer months when 4 IU of oxytocin was injected in the vulva just before insemination. Sows inseminated during the summer months with oxytocin-treated semen or injected with oxytocin at time of insemination had larger ($P < .001$) litters than control sows. Although the use of oxytocin during winter, spring and fall did not significantly increase farrowing rate, litter size was significantly increased throughout the year. Oxytocin was mixed with the semen by gentle shaking.

Table 10. Effect of oxytocin on reproduction of sows bred with semen stored for > 72 hours in Beltsville Thawing Solution extender.

Item	>72 hours of storage	>72 hours of storage + used oxytocin[a]	Difference
Number of sows	55	59	-5
Farrowing rate, %	68.2[b]	85.2	-17
Number piglets born live per litter	9.4[b]	10.1	-.07

[a]5 IU of oxytocin was injected in the muscle 2 to 5 minutes before insemination.
[b]Values are different ($P < .05$) between treatments.
Reference: North Carolina State University Annual Swine Report, pp 89-90, 1995.

Table 11. Effect of oxytocin-treated semen and vulva injection of oxytocin on reproductive performance of sows.

	Farrowing rate, %			Average total number piglets born per litter		
	Oxytocin injected			Oxytocin injected		
Season	In semen[a]	In vulva[b]	Control	In semen	In vulva	Control
Jan to Mar	88.5 (61)[c]	92.9 (56)	87.3 (71)	12.2[x]	10.8[x]	10.1[y]
Apr to Jun	86.4 (59)	80.7 (62)	76.7 (60)	11.9[d]	11.3[d]	10.1[e]
Jul to Sep	73.0[D] (63)	56.3[DE] (64)‘	54.4[E] (57)	10.8[x]	10.5[x]	8.5[y]
Oct to Dec	84.4 (64)	81.7 (60)	77.8 (63)	11.2[x]	11.3[x]	9.8[y]
Overall	83.0	77.3	74.9	11.50	10.97	9.66

[a]4 IU oxytocin added to dose of semen with an insulin syringe just before insemination.
[b]4 IU oxytocin injected in mucosa of vulvar lips with an insulin syringe at time of insemination.
[c]Number of females bred.
[de]Values with different superscript within row are different ($P < .05$).
[DE]Values with different superscript within row are different ($P < .01$).
[xy]Values with different superscript within row are different ($P < .001$).
Reference: Theriogenology 49:829-836, 1998.

Table 12. The influence of duration of insemination on reproductive performance.

Duration of insemination (minutes)	Semen treated with oxytocin			Control		
	Number females	Farrowing rate, %	Total pigs born	Number females	Farrowing rate, %	Total pigs born
	Gilts			Gilts		
2 to 3	2	100.0	11.50	2	100.0	10.50
4 to 5	92	82.6	9.56	96	87.5	10.16
6 to 7	180	77.8	8.75	152	72.3	8.60
8 to 9	39	89.7	8.91	46	73.9	5.32
	Multiparous sows			Multiparous sows		
2 to 3	17	100.0	11.00	18	94.4	13.06
4 to 5	230	87.4	11.09	237	90.7	11.47
6 to 7	125	89.6	11.49	122	86.1	10.74
8 to 9	5	80.0	13.75	8	87.5	7.43

Reference: Archiv fur Experimentelle Veterinarmedizin 31(4):561-566, 1977.

Duration of Insemination

The duration of semen intake was not affected by adding 5 IU of oxytocin to semen. In gilts, the duration of

Table 13. Summary of benefit from using oxytocin in conjunction with artificial insemination.

Study	Farrowing rate	Piglets born live	FI[a] per 100 sows	Profit at $10/head	Cost of oxytocin[b]	Net gain per 100 sows
A	+5.8	+.82	+132	+$1,320	$2.00	+$1,318
B	+1.2	+.04	+15	+$150	$2.00	+$148
C	+3.0	-.20	+15	+$150	$2.00	+$148
D	-5.8	+.50	-14	-$140	$2.00	-$142
E (gilts)	+6.3	+.04	+54	+$540	$2.00	+$538
E (sows)	-.80	+.14	+5	+$50	$2.00	+$48
F (gilts)	-1.8	-.10	-22	-$220	$2.00	-$222
F (sows)	+4.2	+.20	+57	+$570	$2.00	+$568
G (gilts)	-.74	-.12	-14	-$140	$2.00	-$142
G (sows)	+3.5	+.54	+72	+$720	$2.00	+$718
H (gilts)	+.10	+.10	+9	+$90	$2.00	+$88
H (sows)	+1.1	+.11	+20	+$200	$2.00	+$198
I (gilts)	-1.36	-1.09	-102	-$1,020	$2.00	-$1,022
I (sows)	+4.08	+.85	+107	+1,070	$2.00	+$1,068
J (Inexp. person)	+12.1	+.8	+186	+$1,860	$2.00	+$1,858
J (Exp. person)	+5	+.4	+87	+$870	$2.00	+$868
K (old semen+oxy)	+17	+.07	+219	+$2,190	$2.00	+$2,188
L (oxy in semen)	+8.1	+1.84	+231	+$2,310	$2.00	+$2,308

[a]FI is fecundity index.
[b]$4.00 per 100 mL of oxytocin (20 IU per mL); 5 IU per dose; 1¢ per dose; 2 doses per sow.

insemination averaged 5.8 minutes for females inseminated with oxytocin-treated semen and 5.9 minutes for control females. The duration of insemination averaged 5.1 minutes for both sows inseminated with oxytocin-treated semen and control sows. The influence of duration of insemination on farrowing rate and total number of piglets born per litter is indicated in Table 12. In general, farrowing rate was greater for the shorter durations of insemination (2 to 5 minutes) than longer durations of inseminations (6 to 9 minutes). The addition of oxytocin to semen improved the farrowing rate of gilts when the duration of insemination was 6 minutes or longer.

Economics

Many studies did not find a statistically significant advantage for using oxytocin in conjunction with artificial insemination on farrowing rate or litter size born live; however, the majority of the studies showed a numerical increase in farrowing rate and litter size for sows inseminated with oxytocin-treated semen. A few studies found: (1) farrowing rate to be significantly improved without a significant improvement in litter size born live, (2) litter size to be significantly improved without a significant improvement in farrowing rate, (3) farrowing rate to be significantly improved only during the summer months, and (4) both farrowing rate and litter size to be significantly improved. Table 13 is a summary of the effect of using oxytocin in conjunction with artificial insemination on farrowing rate and litter size for the studies presented.

Instead of evaluating the economic benefit of oxytocin on individual traits (farrowing rate and litter size), it is better to make an economic evaluation based on an FI. An FI is the product of farrowing rate times litter size; thus, the FI helps determine the overall effect of using oxytocin in conjunction with artificial insemination on reproductive performance.

The cost of oxytocin per dose of semen is very cheap. For example, if the cost of 100 mL of oxytocin (20 IU per mL) is $4, the cost per dose of semen is 1 cent (5 IU of oxytocin per dose). The use of oxytocin was profitable in 77.8% of the data sets reported in Table 13. Three of the four data sets that had a negative effect on net gain per 100 females when using oxytocin used gilts.

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