



Suckling effects on the sow: Does teat use in 1st lactation affect its milk yield and development in 2nd lactation?

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OUTLINE:

- ✓ **Mammary gland development**
 - **when**
 - **how**
- ✓ **Mammary involution**
 - **when**
 - **how**
- ✓ **Teat use project**

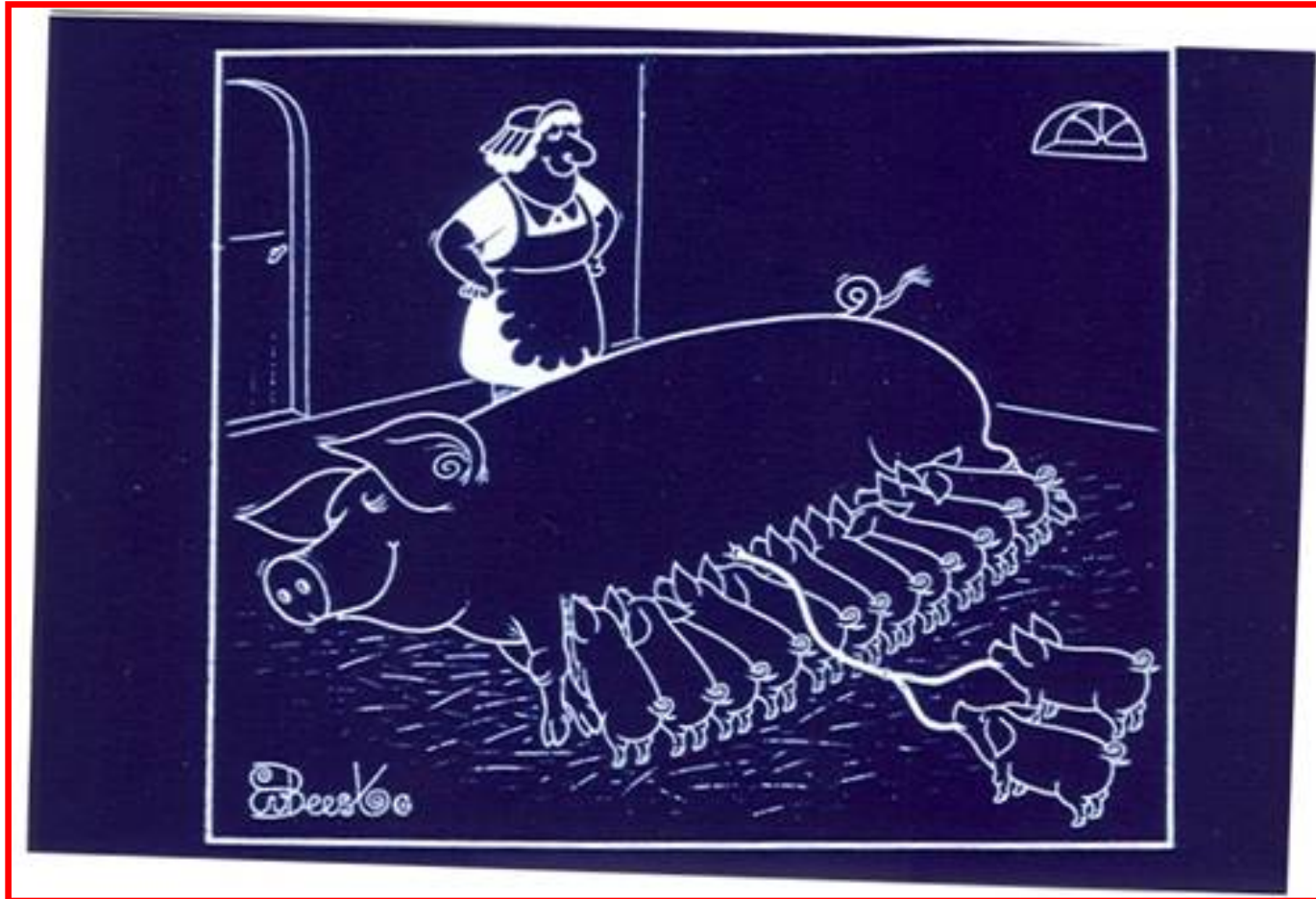


The sow is not producing enough milk to sustain maximal piglet growth

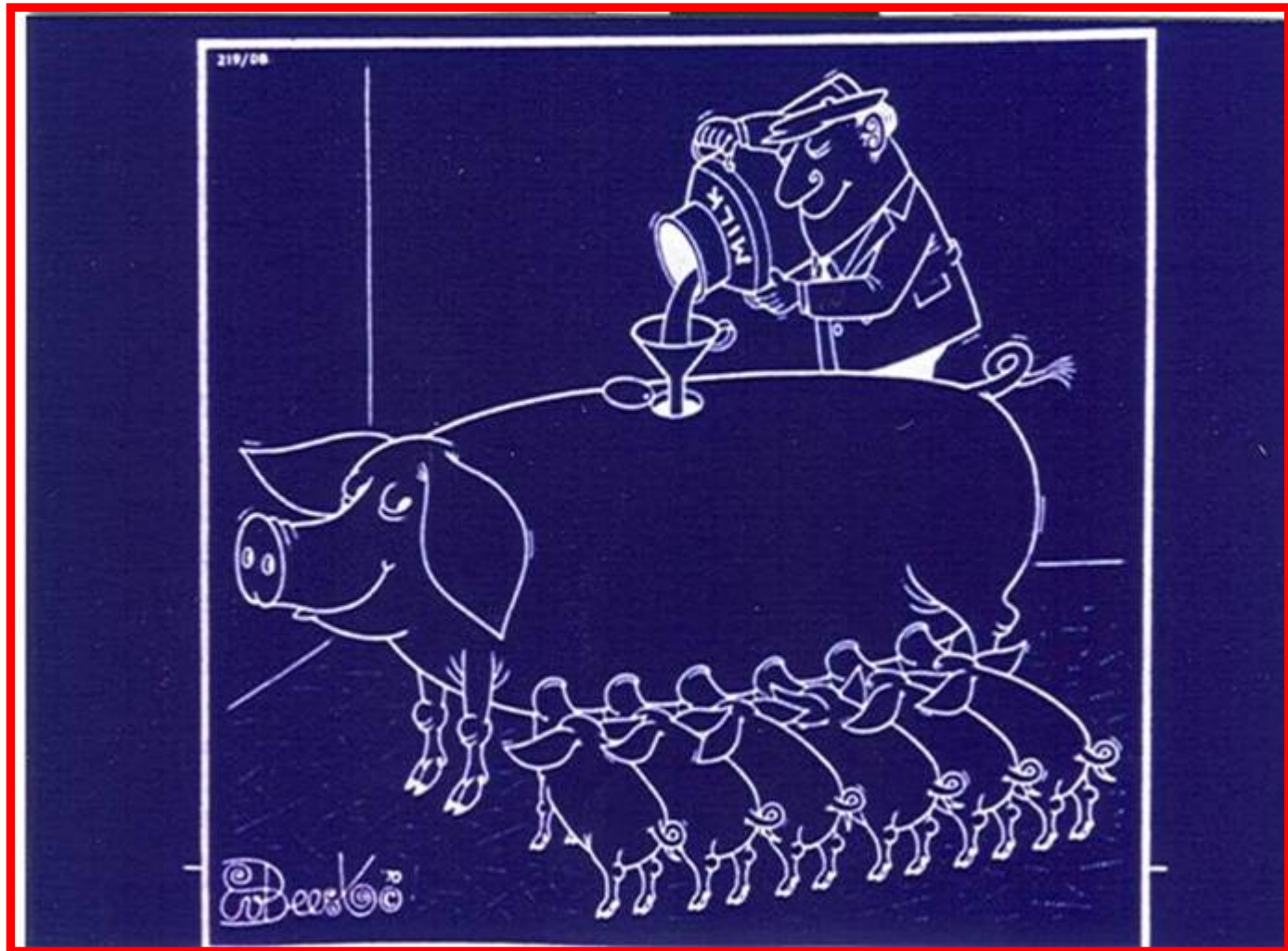


I would prefer milk!

This was exacerbated with the venue
of hyperprolific sows



How can we increase sow milk yield?



**Main factor limiting
milk yield**



**# of secretory cells present in
mammary tissue at the
onset of lactation**

Head et al. 1991

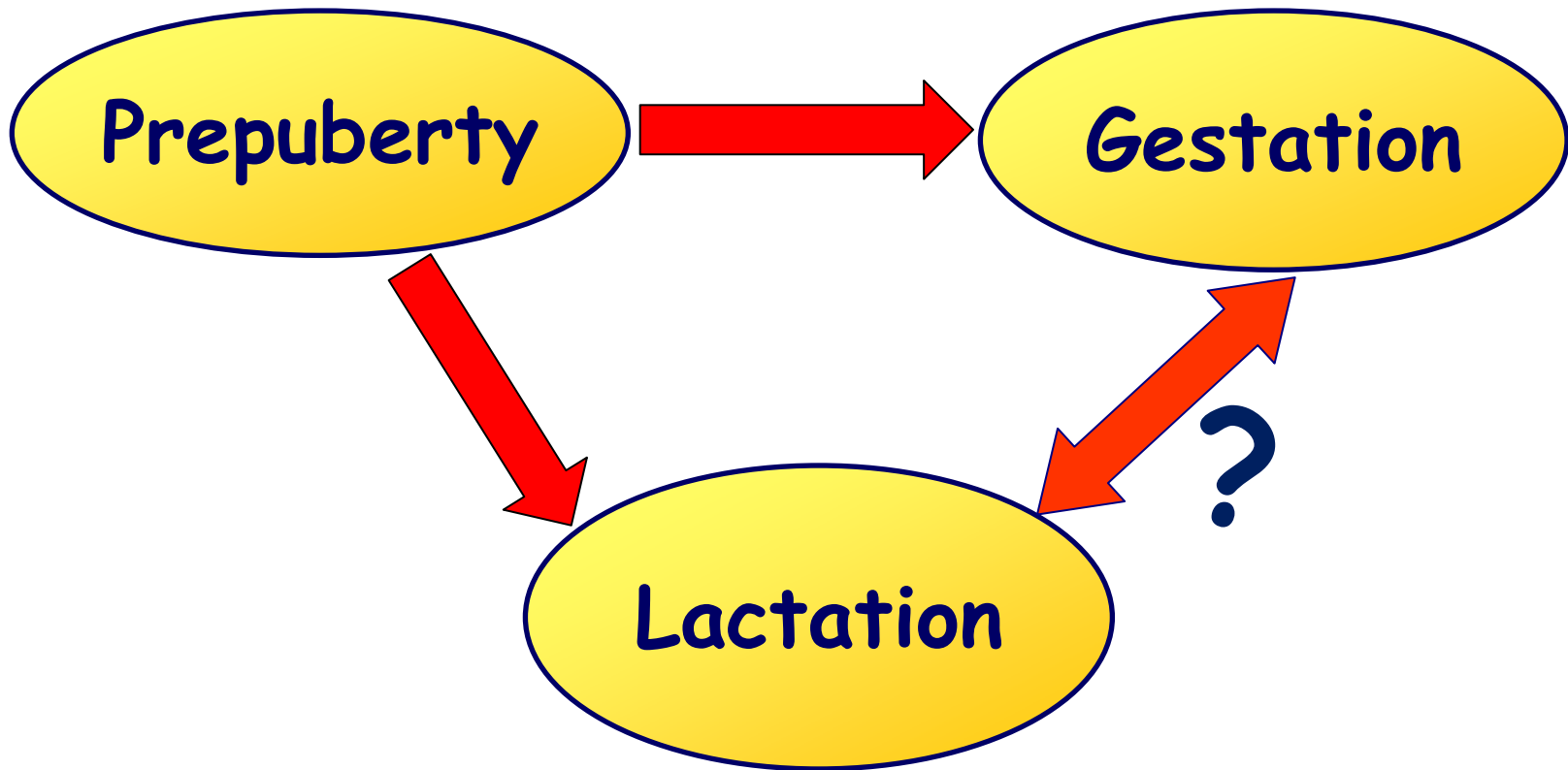


Mammary development

❖ WHEN?

❖ HOW?

Mammogenesis occurs at 3 stages



Ontogenesis of mammary development

At birth:

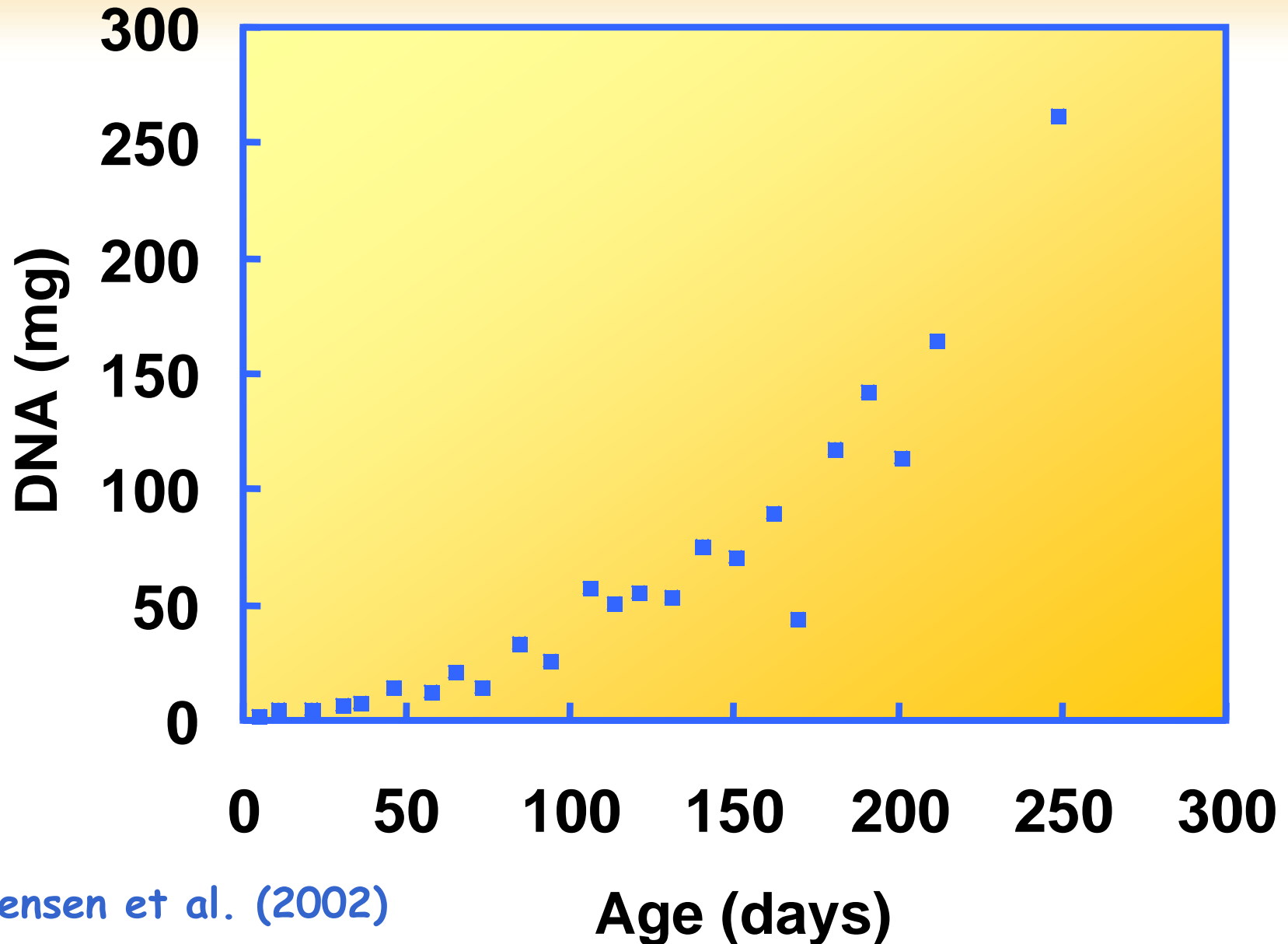
- ✓ mainly stromal tissue
- ✓ poorly developed duct system

At 3 months of age:

- ✓ important mammary growth
- ✓ until puberty



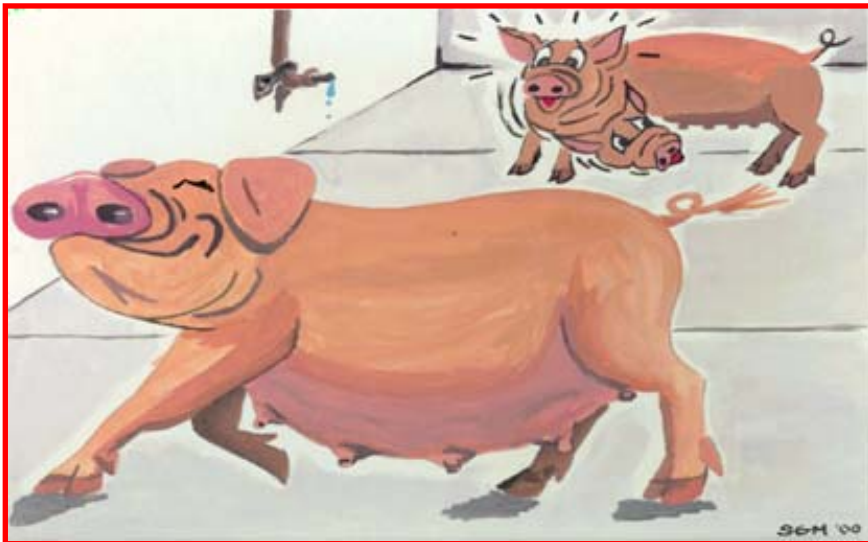
Ontogenesis of mammary development



Sorensen et al. (2002)

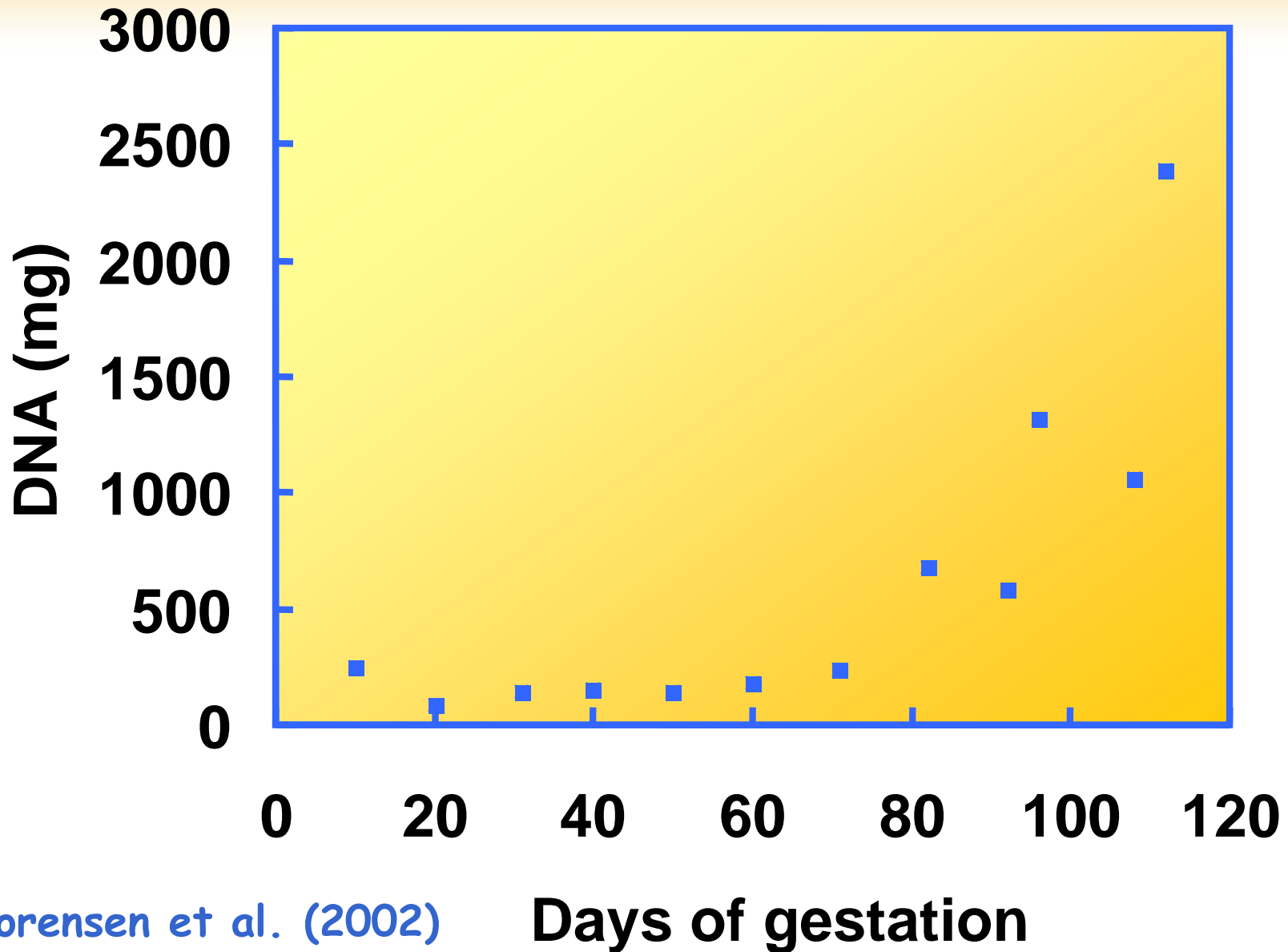
Mammary development (puberty)

- ✓ extraparenchyma ↓ : 1286 vs 1528 g
- ✓ parenchyma ↑ : 376 vs 249 g
- ✓ important duct system



Essential role
of estrogens

Ontogenesis of mammary development



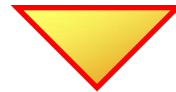
Sorensen et al. (2002)

Changes in gestation

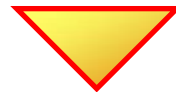
adipose tissue



alveolar tissue (d 78-80)



milk secretion within alveoli (d 90-105)



lactogenesis

- multiparous sows (starts 1 week later)

Mammary development (lactation)

- ✓ mammary hyperplasia and hypertrophy
- ✓ multiparous > primiparous
- ✓ related to position of the gland on udder
 - ❖ 5 more anterior teat pairs > other pairs
- ✓ between days 5 and 21:
 - ❖ ↑ 50% wet weight
 - ❖ ↑ 44% [DNA]



Mammary gland composition

Day of lactation						
	5	10	14	21	28	
Surface area (cm ²)	47.2	49.6	55.8	60.5	62.4	↑
Weight (g)	381	408	487	593	582	↑
Protein (%)	39.4	35.5	46.1	44.8	47.8	↑
Fat (%)	55.1	58.4	47.6	48.9	46.0	↓
DNA (%)	0.77	0.77	0.95	1.11	1.04	↑

Kim et al. (1999)

Mammary involution:

- ✓ **Essential process:** rapid regression within 7-10 d post-weaning
 - more than 2/3 ↓ in wet weight and in parenchymal DNA
 - unused glands in lactation show no further ↓ after weaning



Mammary involution at weaning

Days post-weaning						
	0	2	3	4	5	7
Surface area (cm ²)	59.7	43.9	47.2	38.4	31.4	26.8
Weight (g)	486	314	304	248	202	152
DNA (mg/gland)	839	489	474	461	329	278
Protein (g/gland)	56.1	36.2	35.0	28.6	23.3	17.5
Fat (g/gland)	45.4	44.5	48.3	31.7	26.1	20.1

Ford et al. (2003)

Mammary involution in lactation

- ✓ Rapid regression of unused teats in early lactation (7-10 d)
 - mammary tissue ↓ by 2/3
 - stable thereafter
 - affected by nutrition: ↓ with ↑ E & P
- ✓ Reversible within 24 h postpartum:
 - but milk yield remains lower until day 27 of lactation

(Kim et al. 2001)

Mammary involution:

- ✓ **Irreversible after 3 d:** based on expression of α -lactalbumin (↓) PRLR (↓) and IGFBP-5 (↑) genes
- ✓ **Role of suckling:** effects of no suckling, transient suckling (to 12-14 h postpartum) or regular suckling on d 0 to 6 of lactation
 - transient or non-suckled teats regressed
 - PRLR mRNA ↓, IGFBP-5 mRNA ↑ in transient and unsuckled glands

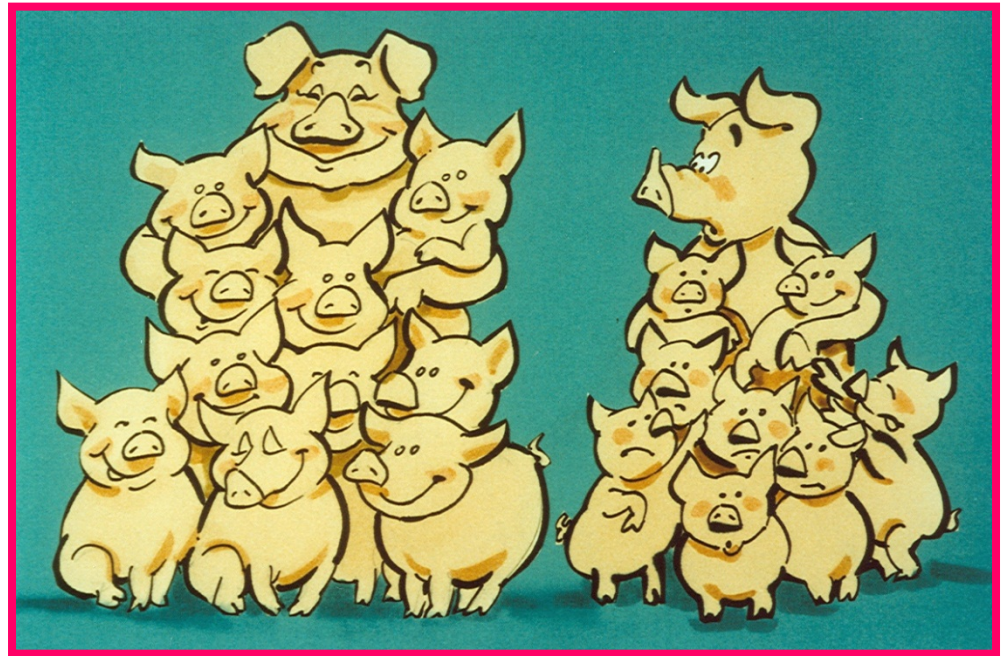
(Theil et al. 2005,2006)

Mammary involution:

✓ **Re-initiation** of alveolar development is required during the next gestation

✓ Teats which are **nursed** are larger after post-weaning involution ??

(Ford et al. 2003)



Question:

What is the possible impact of the non-use of a teat in 1st lactation on its milk yield in 2nd lactation?



Project by Fraser et al. (1992):

- ✓ **Lactation 1**: either front half of the udder (teat pairs 1 to 3) or posterior half (teat pairs 4 to 7) covered
- ✓ **Lactation 2**: all teats left uncovered

Project by Fraser et al. (1992):

- ✓ **Lactation 1**: either front half of the udder (teat pairs 1 to 3) or posterior half (teat pairs 4 to 7) covered
- ✓ **Lactation 2**: all teats left uncovered
 - piglet preference for front teats irrespective of whether covered or not previously
 - covering posterior teats in 1st lactation
 - ↑ differences in piglet weight gain between piglets suckling front vs. posterior teats

Project by Fraser et al. (1992):

- ❖ suggested an effect of teat use on subsequent productivity...
- ❖ but, confounding effect of teat position

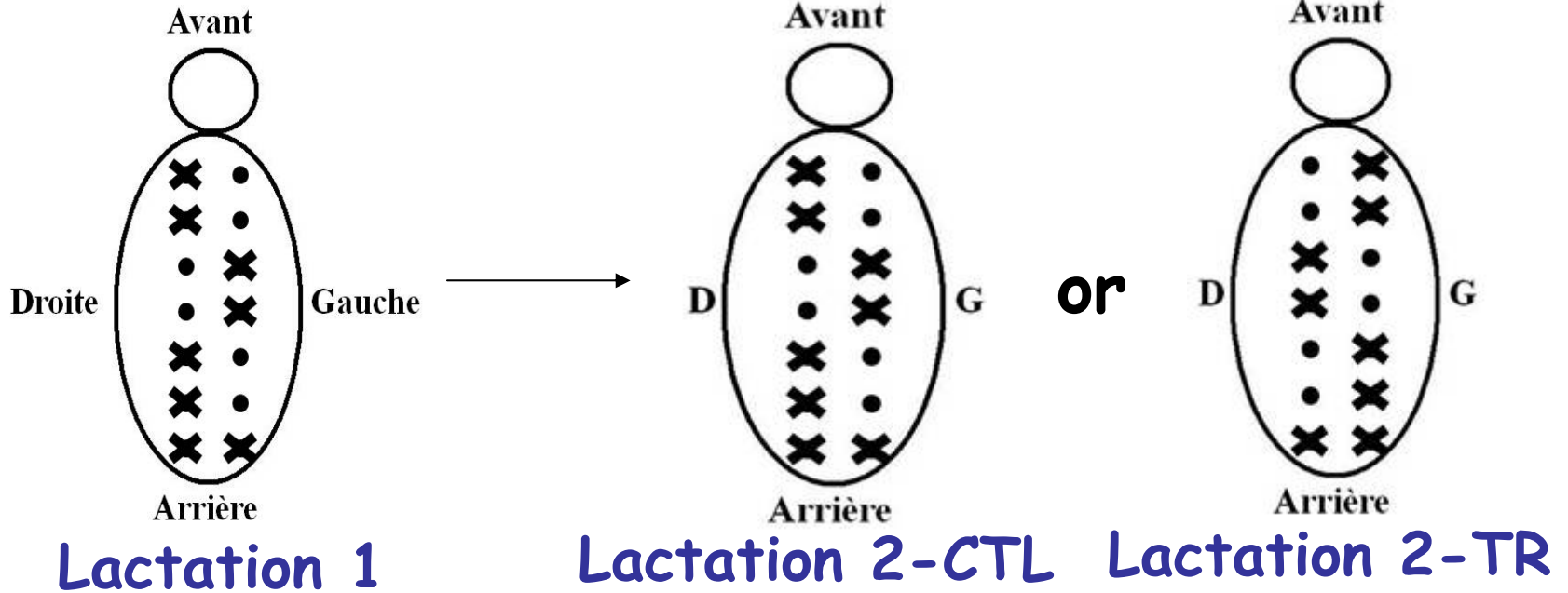


Teat use project



Blocking the same teats or different teats during the 1st and 2nd lactation

Teat use project



average of 14
functional teats

6 piglets per
litter

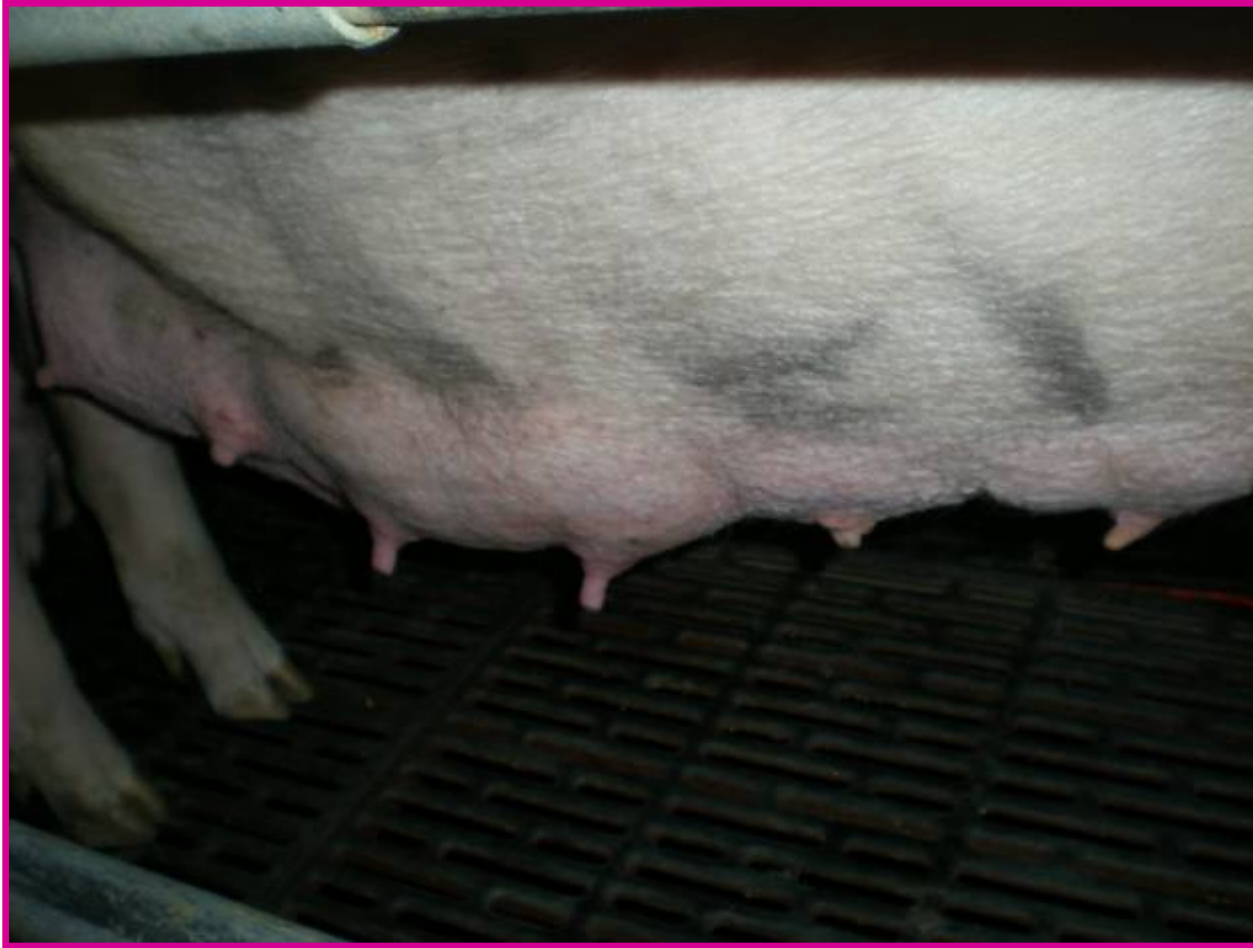
Teat use project



Materials and methods:

- 21 CTL sows (same teats used)
21 TR sows (not same teats used)
- at the end of farrowing, litters uniformized to 6 piglets
- 1st lactation - weaning at 21 d
2nd lactation - weaning at 17 d
- sows slaughtered at weaning of 2nd lactation

Teat use project



End of 1st lactation (tape removed on d 7)

Teat use project



Teat use project



SOWS (parity 2)	CTL	TR
Weight (kg): d 2	249	245
d 17	237	234
- difference (d 17-2)	-11.1	-10.7
Backfat (mm): d 2	21.3	22.7
d 17	21.3	21.6
- difference (d 17-2)	-0.3	-1.3

Teat use project



SOWS	CTL	TR
Feed intake (kg/d):		
- week 1	4.07**	3.34
- week 2	5.03*	4.50
- week 3 (d 15+16)	5.52†	5.03

**P<0.01, *P<0.05, †P<0.10

Teat use project



MILK COMPOSITION	CTL	TR
Dry matter (%)	18.8	18.5
Fat (%)	7.5	7.2
Protein (%)	4.9	4.9
Lactose (%)	5.2	5.2

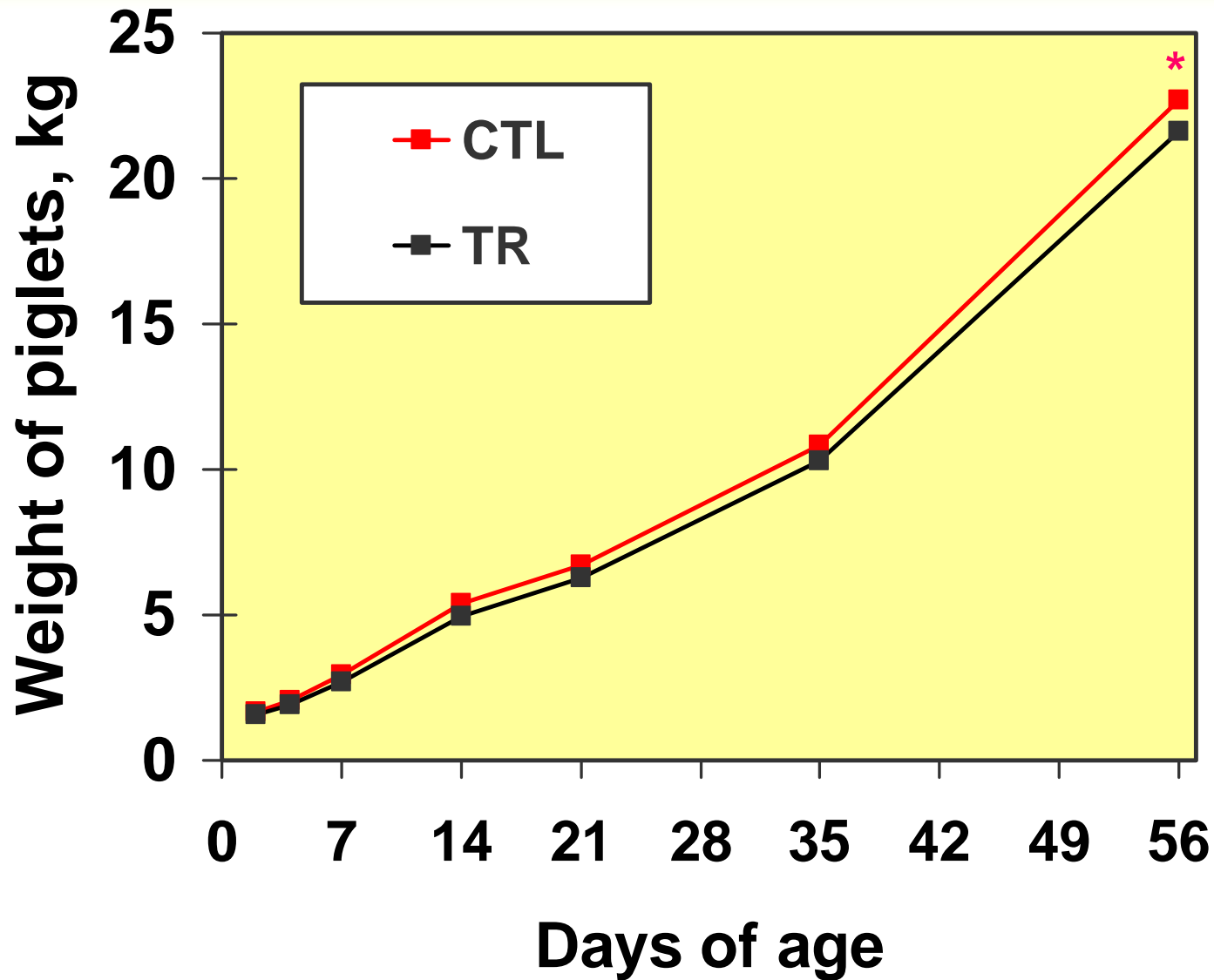
✓ No difference

Teat use project



SOW HORMONES	CTL	TR
Urea (mMol/L)		
- d 2	7.9	8.1
- d 17	11.0†	9.7
Prolactin (ng/mL)		
- d 2	34.2	37.4
- d 17	19.8	18.6
IGF-I (ng/mL)		
- d 2	99.3	93.1
- d 17	196.3	163.2

Teat use project



Teat use project



Piglet weight (kg):	CTL	TR
d 2	1.65	1.57
d 4	2.08	1.93
d 7	2.92	2.71
d 14	5.39	4.97
d 21	6.73	6.29
d 35	10.83	10.28
d 56	22.72*	21.60

Teat use project



Weight gain (kg):	CTL	TR
d 2 to 4	0.43*	0.35
d 4 to 7	0.84	0.78
d 7 to 14	2.47*	2.26
Lactation (d 2 to 14)	3.74*	3.40
d 14 to 21	1.35	1.39
d 21 to 28	4.09	3.99
d 28 to 56	11.9	11.3

Teat use project



MAMMARY GLAND	CTL	TR
Extraparenchyma (g)	692.5	714.3
Parenchyma (g total)	3004.1 [†]	2608.7
Parenchyma (g/teat)	800.4*	641.6
-dry matter (%)	20.4	20.6
-protein (%)	52.0	52.9
-protein (g total)	317.0 [†]	283.3

Teat use project



MAMMARY GLAND	CTL	TR
Parenchyma:		
-DNA (mg/g parenchyma)	11.1	10.6
-DNA (g total)	6.8 [†]	5.7
-DNA (g/teat)	1.8*	1.4
-RNA (mg/g parenchyma)	24.7	25.4
-RNA (g total)	14.9	13.6
-RNA (g/teat)	4.0*	3.3

Teat use project



MAMMARY GLAND (gene expression)	CTL	TR
Prolactin	0.027 [†]	0.022
Prolactin receptor	0.564	0.497
STAT5A	0.604	0.536
STAT5B	0.549	0.512
IGFBP5	9.95	10.54
α -lactalbumin	-0.515	-0.721

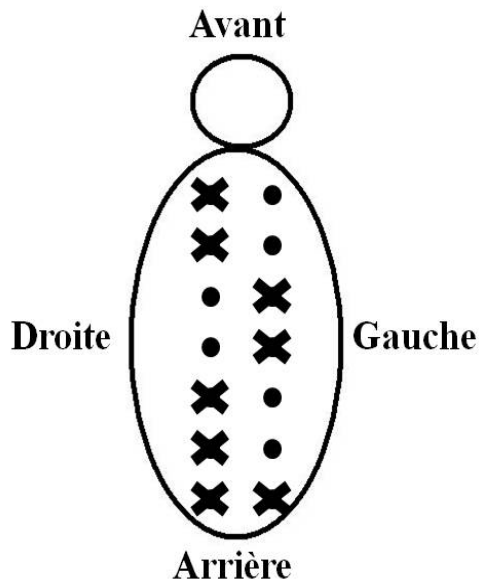
Teat use project



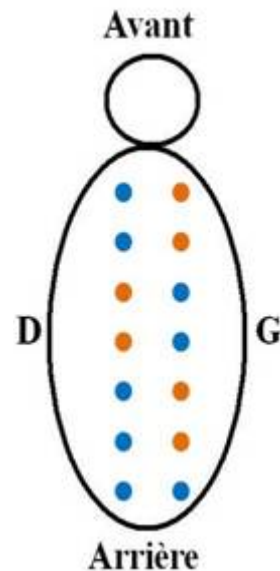
Behavior (day 3):	CTL	TR
-nursing interval (min)	41.5	38.5
-pre-ejection phase (min)	2.3	2.0
-post-ejection phase (min)	2.5	3.2*
-# fights/day	64.3	114.3 [†]
-% teats with fights	67.7	77.6 [†]
-% nursings missed	2.0	4.0 [†]
-% teat fidelity	93.9	91.5

➤ on day 10: no effect

Teat use project: preference



Lactation 1



Lactation 2

teats taped in
lactation 1
but not in
lactation 2

8 piglets
per litter

Teat use project: preference



activity and aggressiveness around teats in 2nd lactation (comparison between teat types)

✓ with 8 sows

	Not taped 1 st lact	Taped 1 st lact
# fights	13*	6
fight duration (sec)	23 [†]	14
occupation of teats (% of suckling duration)	59*	43
average # of piglets at milk ejection/day	1.9*	1.6

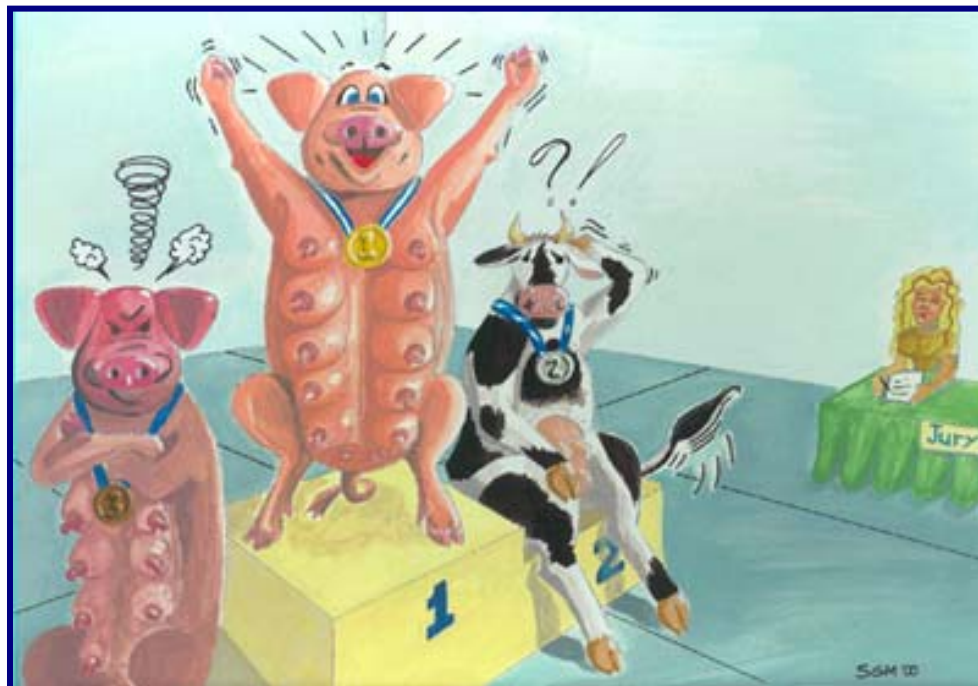
Teat use project: preference



- ✓ in 2nd lactation, piglets seem to prefer teats that were used before



Concluding remarks



- ❖ management of sows in their 1st lactation is important for their performance in 2nd lactation

Thank you !

