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Stress during gestation alters immune cell numbers but not immunoglobulins in mammary secretions of sows

Merlot E¹, Prunier A¹, Quesnel H¹

1. INRA, UMR1348 PEGASE, F-35590 Saint-Gilles, France.

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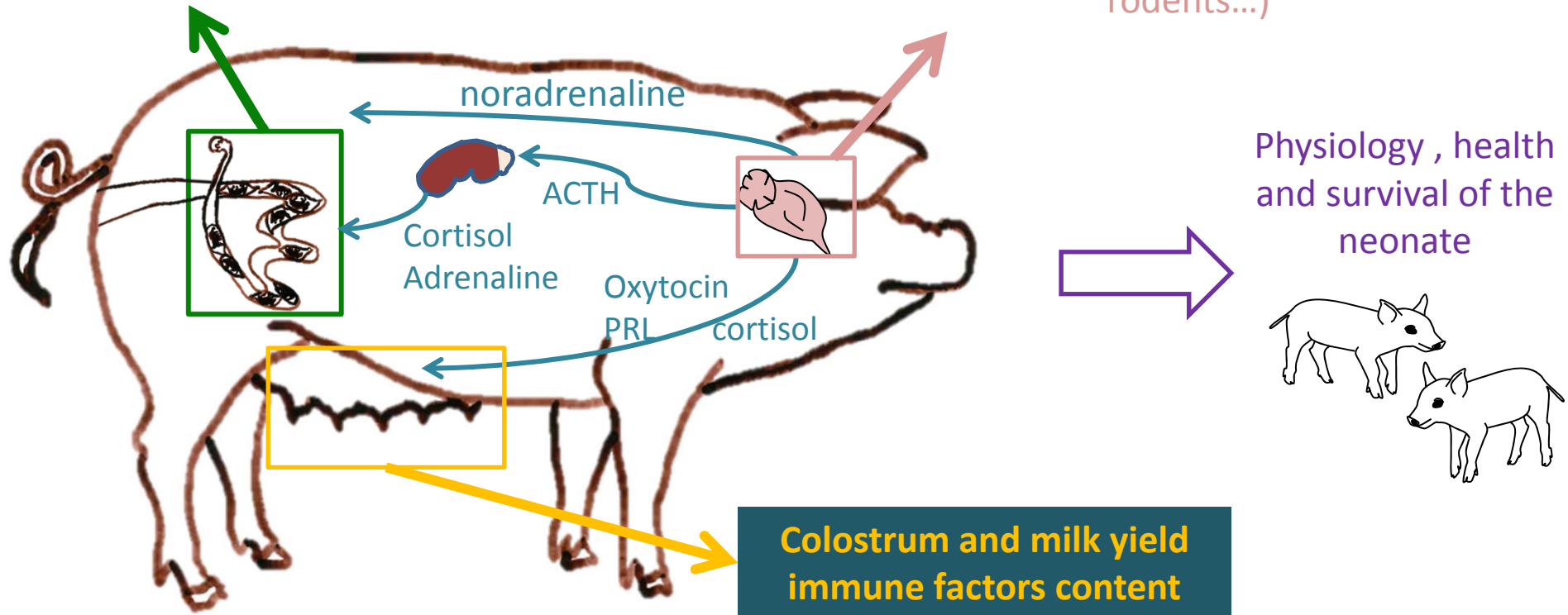


Context: Prenatal stress, neonatal health and survival

Placental morphology (pig) and
endocrine and trophic functions (rodents, primates)
Fetal ontogenic development (rodents, primates, ungulates)
Fetal growth (rodents, primates)

Maternal behavior
(pig, ruminants, human,
rodents...)

Physiology, health
and survival of the
neonate



Context

Humoral and cellular factors of maternal immunity in swine

- **Immunoglobulins**
 - . Colostrum : mainly IgG derived from sow serum
 - . Milk : mainly IgA synthesized locally in MG
- **Cells:**
 - . Polymorphonuclear cells (PMN)
 - . T and B lymphocytes
 - . Monocytes / macrophages
- **Immunomodulating and non-specific antimicrobial components**
 - . cytokines, chemokines
 - . Milk: lactoferrin, transferrin, lysozyme, lactoperoxidase
- **From 0 to 24-36 h :** Transcytosis across the epithelial cells of the gut of colostrum immunoglobulins, cytokines and immune cells
- **During lactation:** . protection from digestive pathogens

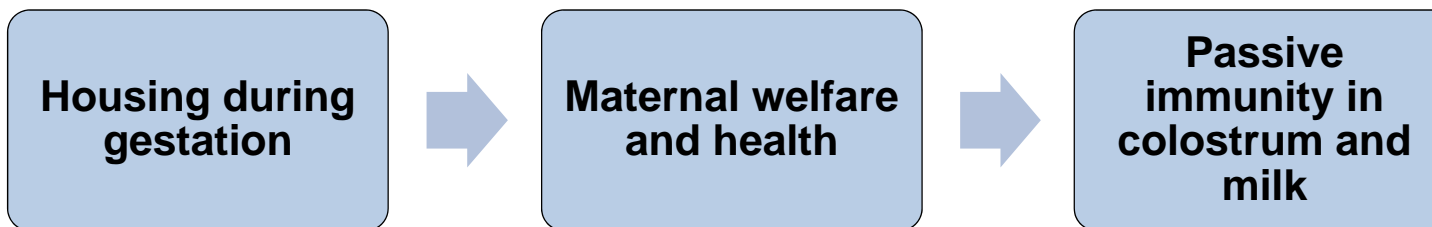
Context Impact of stress of pregnant females on colostrum and milk production

- **Effects of experimental or natural exposure to heat stress during gestation in cows**
 - ↘ colostrum and milk yield,
 - ↘ fat and protein content
 - ↘ IgG and IgA content
- **Effect in other animals but cows?**
- **Effects of other experimental stressors (more “psychological” stress factors) ?**
- **And apart immunoglobulins?**

Context: Stress of pregnant sows in intensive pig husbandry



- Consequences of these natural stressful conditions on passive immunity transfer?



Experimental design

- 3 successive batches of pregnant Large-White x Landrace sows



Conventional housing

Group housed
(2.4 m²/ sow, on slat)
C, n=50

Conventional farrowing crates



Pre-weaning mortality
26%

DG0

DG105 DG114 (Farr.)

Conventional housing

Enriched housing



Enriched housing

Group housed
(3.4 m²/ sow, on deep straw)
E, n=56

Pre-weaning mortality
17%

18 C sows and
19 E sows

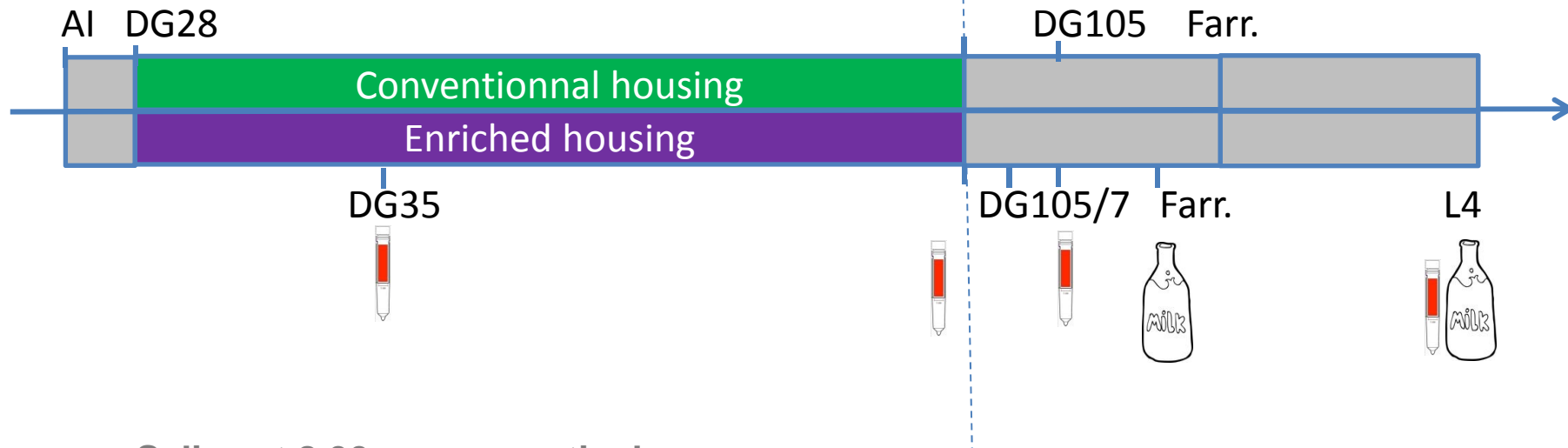
Experimental design



or



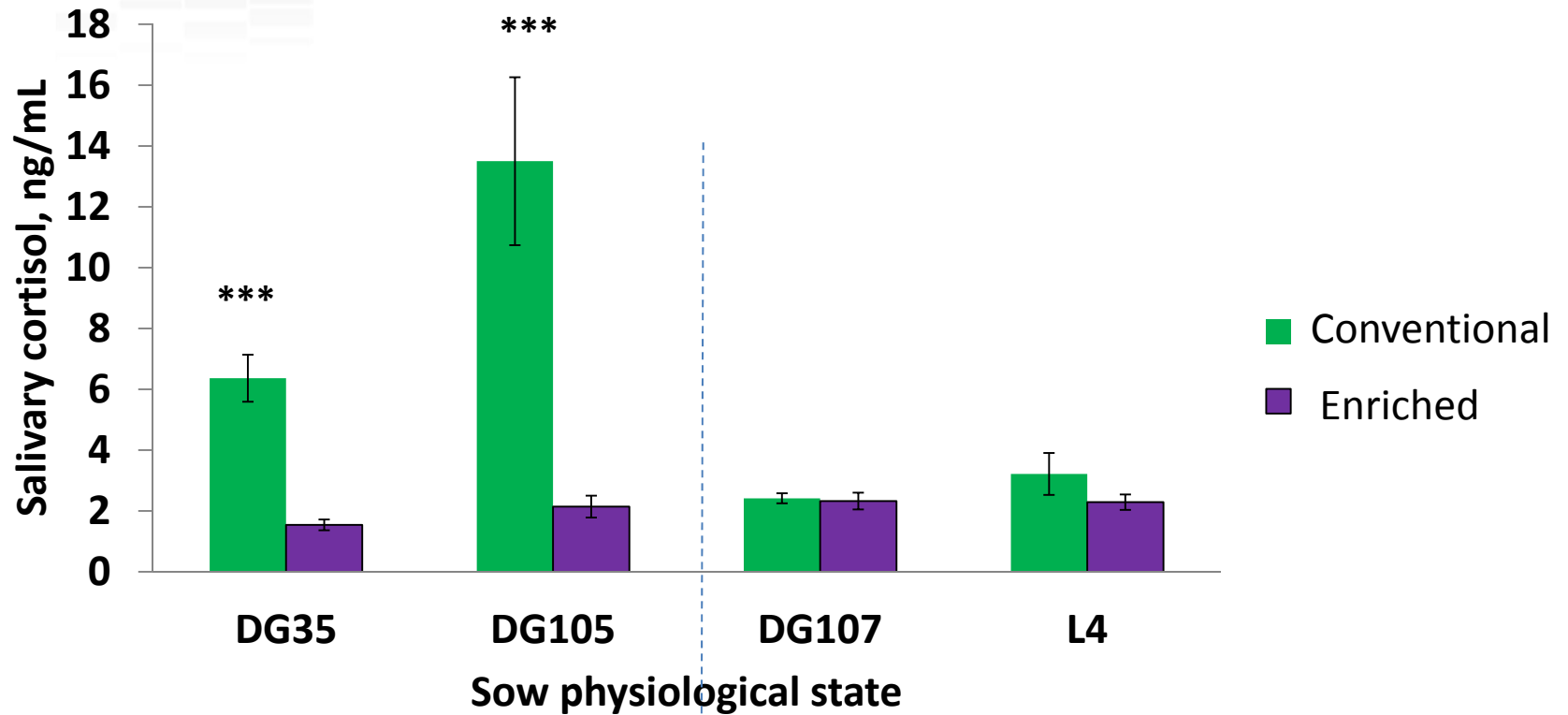
Conventional farrowing crates



- Saliva at 8.00 a.m => cortisol
- Colostrum and milk => IgG, IgA, leukocytes analysis by flow cytometry

Salivary cortisol

Greater stress level in the conventional system during gestation



or



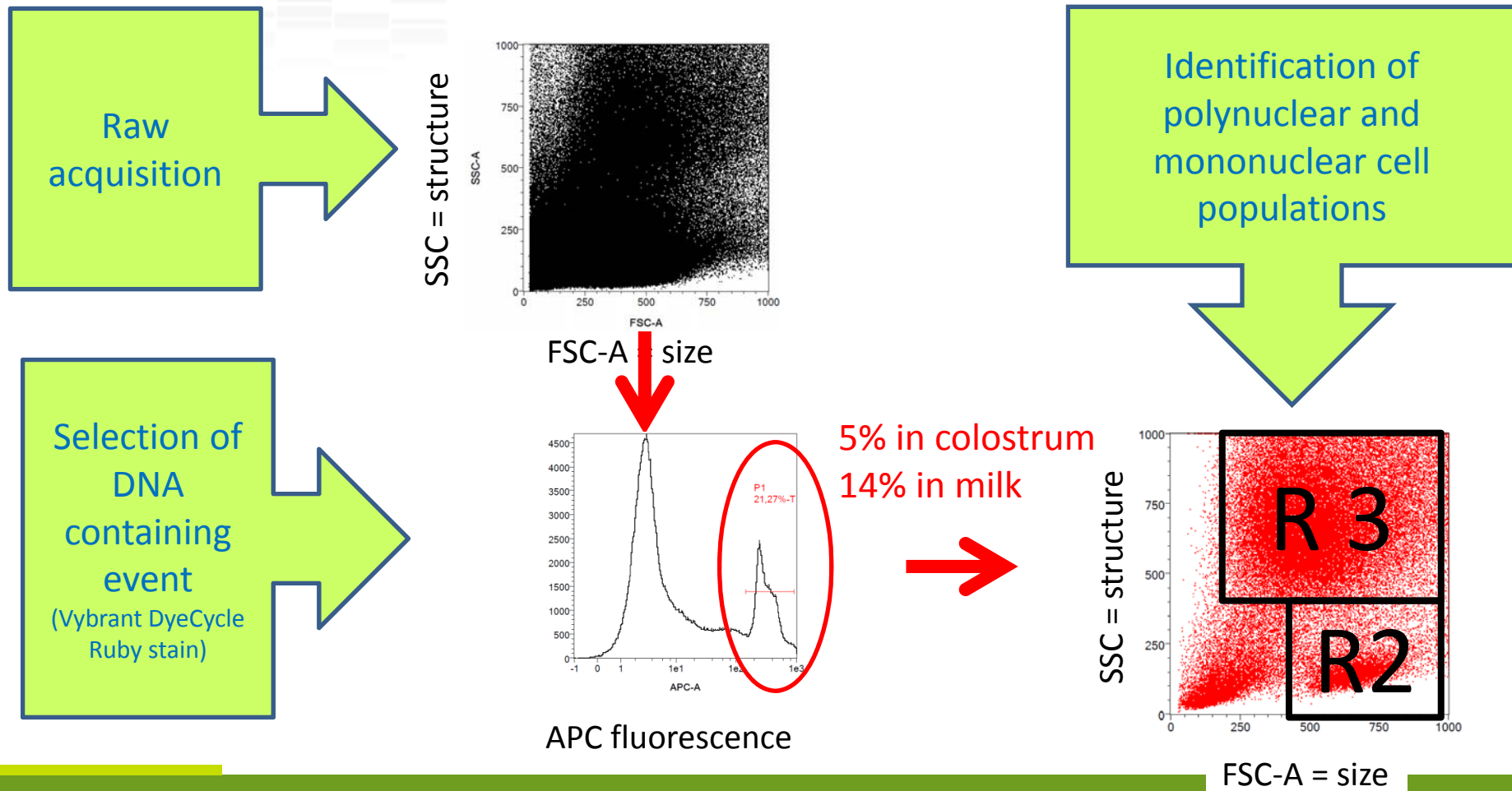
Colostrum and milk immune composition

Comparable immunoglobulin content in mammary secretions of C and E females.

		System		sem	P-value
		C	E		
Colostrum (lactation day 0)	IgG, g/L	67	52	27	ns
	IgA, g/L	9	8	4	ns
Milk (lactation day 4)	IgG, g/L	1.0	0.8	0.6	ns
	IgA, g/L	2.5	2.1	0.8	ns

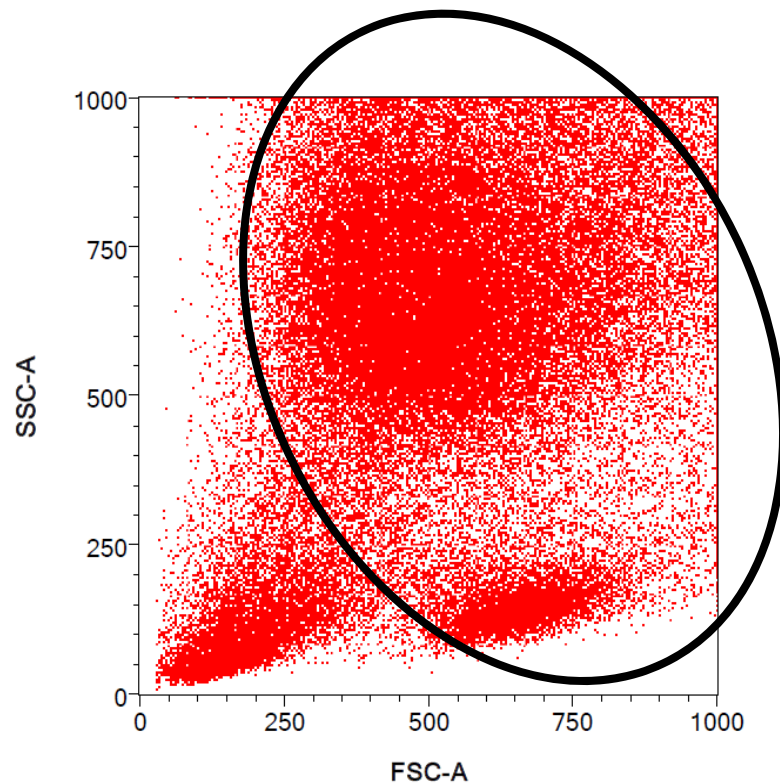
Colostrum and milk cellular composition

Colostrum and milk sample analysis strategy



Relative proportions of immune cells in colostrum and milk

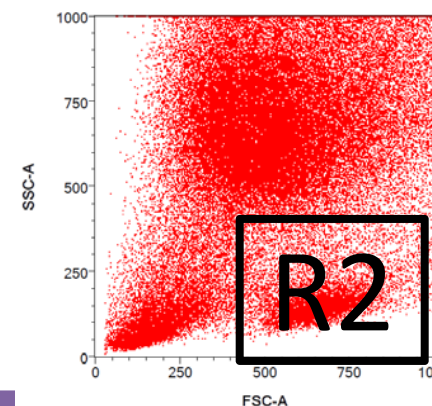
Comparable proportions of leukocytes in C and E milk and colostrum samples



65% of the cells are CD45⁺ (leukocytes)

Relative proportions of immune cells in colostrum and milk

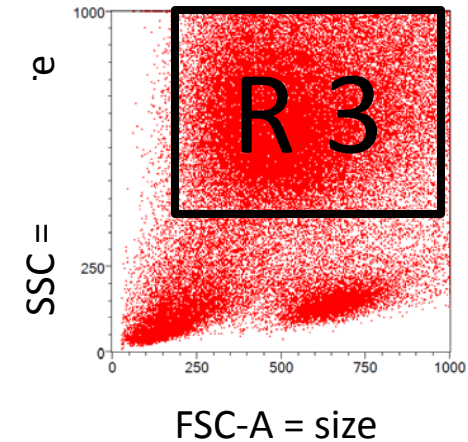
Comparable proportions of monocytes and T lymphocytes



	L0		L4		
R2 gate	C	E	C	E	P-value
% CD2⁺CD8^{low} (memory T cells)					
	27	24	27	23	ns
% CD2⁺CD8^{high} (T CD8 lymphocytes)					
	28	33	44	44	ns
% CD8⁻CD4⁺ (T CD4 lymphocytes)					
	22	15	15	18	ns
% CD172⁺ (monocytes)					
	31	37	19	19	ns

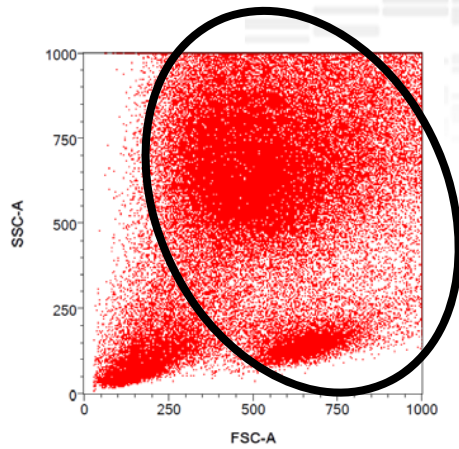
Relative proportions of immune cells in colostrum and milk

Comparable proportions of polynuclear cells in E and C samples



	L0		L4	
R3 gate	C	E	C	E
% CD172 ⁺ (polynuclear cells)				
	63	73 ^t	58	51

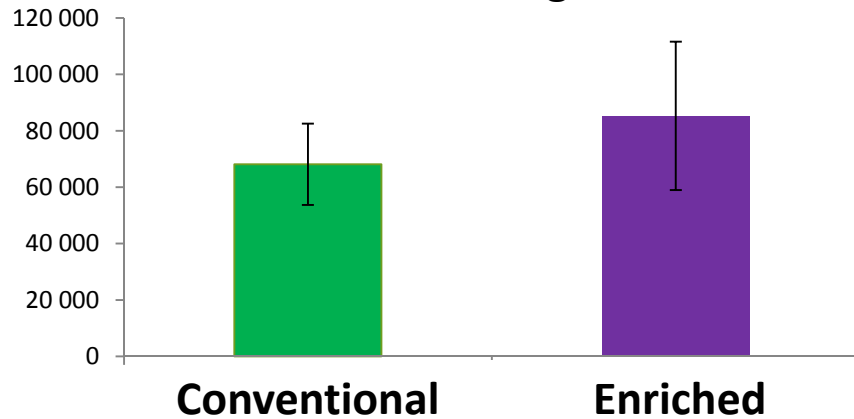
Total cell numbers in colostrum and milk



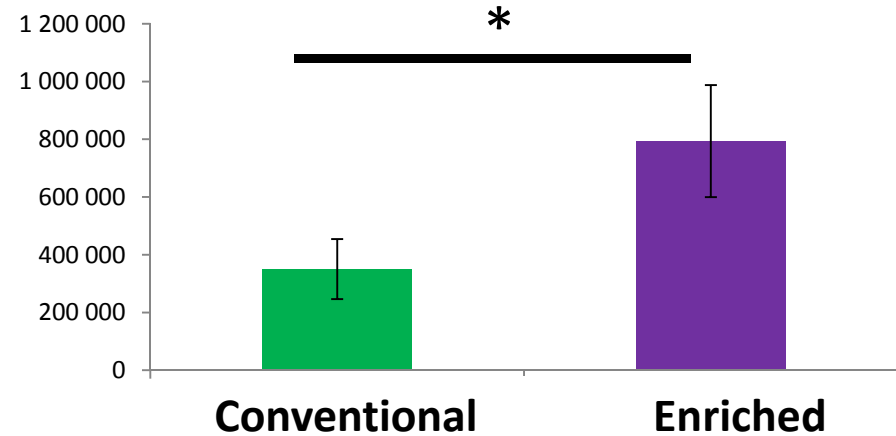
Greater total number of cells in E compared to C in milk samples.

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Cells /mL colostrum at farrowing



Cells / mL milk at L4



What can be the mechanism for increased cell numbers in the milk of E sows?

Subclinical mastitis? Other health disturbance?

- ✓ No sign of mastitis
- ✓ Furthermore E sows had lower blood markers of inflammation during late gestation (data not shown)

An effect of milk “dilution”?

- ✓ But IgG, IgA and nutritional compounds (protein, lipid and lactose %) were unaltered...

Effect of stress on hormonal control of immune cell homing to the mammary gland?

- ✓ Prolactin can be increased by chronic stress (rodents) and controls the migration of immune cells to the MG in non pathogenic state

Conclusion

Thus, chronic stress of pregnant sows reared in a poor environment is associated to

- . increased neonatal mortality of the piglets
- . lower transfer of maternal immune cells to the young in the milk

Whether there is a causal relationship between these phenomena is not known.



Thanks for your attention!

