INNOVATION IN LIVESTOCK PRODUCTION: FROM IDEAS TO PRACTICE

Fetal programming of high salt water : Hematological and intraruminal mechanisms

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PLAN

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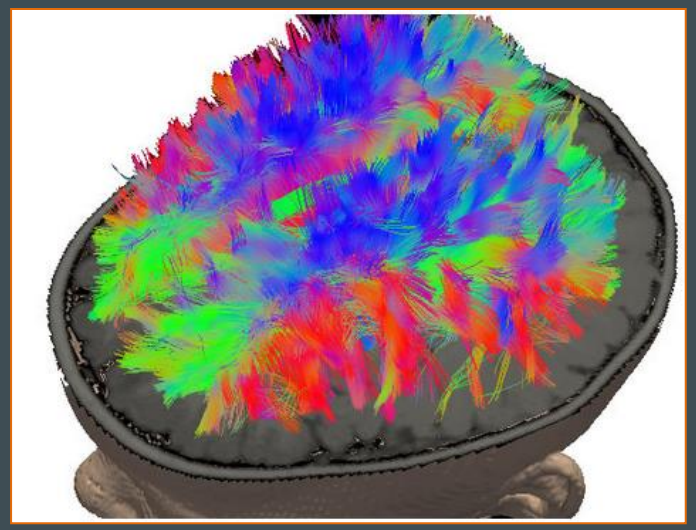
Definition



(Martin-Gronert and Ozanne, 2006)

Fetal programming is an adaptive response to stimuli during the fetal life that is translated into long-term or permanent changes in the structure or function of the body.

Introduction

- An **ESSENTIAL NUTRIENT** for sheep :
  - Maintaining body fluids and proper ionic and osmotic balance.
  - Digesting, absorbing and metabolizing nutrients.
  - Eliminating waste materials and excess heat from the body.
  - Providing a fluid environment for the developing fetus.
  - Transporting nutrients to and from the body tissues.

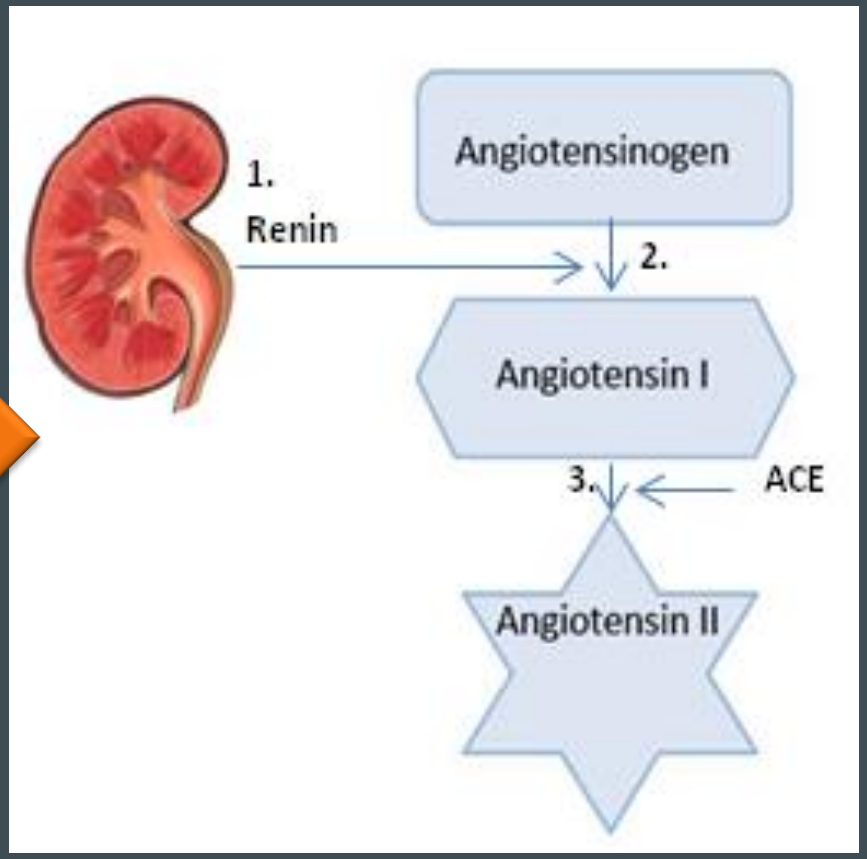
Introduction

- In Tunisia , water is saline-brackish well water.
- in the world , 20% of agricultural land and 50% of crop land are salt stressed.

Introduction

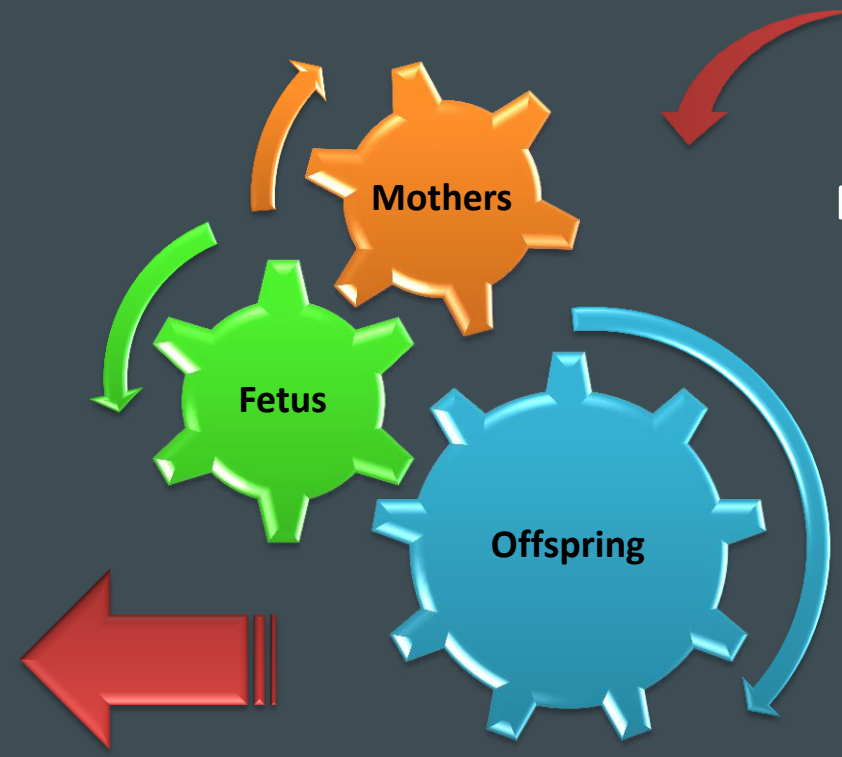
Water and salt balance

Renin–Angiotensin System (RAS)



Litterature : Foetal programming

Embryonic life



Manipulation of maternal water quality

Improve performances and animal health

Rats (Arguelles et *al.*, 1996; Michella et *al.*, 2006; Ramos et *al.*, 2010; Alves-Rodrigues et *al.*, 2011).

Sheep (Annett et *al.*, 1996; Mortiz et al., 2000; Amanda et al., 2007; Koleganova et al., 2008; Munoz et al., 2008; Tay et *al.*, 2012).

Objectifs

Whether pregnancy alters the ability of the animal to cope with a high-salt water

Hematological and intraruminal mechanisms

MATERIAL AND METHODS

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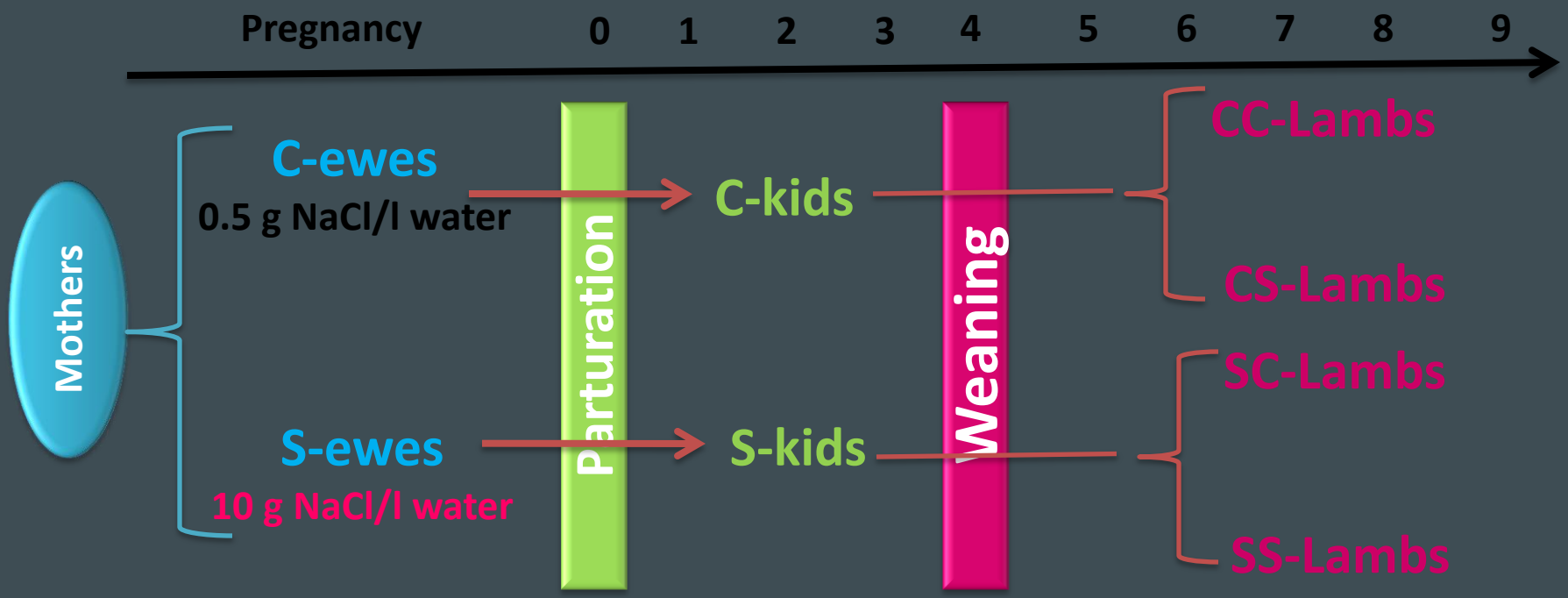
General

- **Weslatia Station for Agricultural Research of the INRA-Tunisia:**
  - **180 km southeast of Tunisia (altitude: 360 m)**
  - **Semi arid climat (average rainfall: 250 ml)**
- **All animals were kept under natural photoperiod and ambient temperature.**

Experimental design



70 Barbarine ewes
Age: 5 years
Weight: 45 kg

Heamtological tests

Rumen fermentation

Diets (growing period)

- **1 kg of hay plus concentrate feed mixture** to cover 50% of their energy maintenance requirements **(Kearl, 1982)**.
- **Grow rate: 100 g per day.**

- **Concentrate feed mixture :**

80% soybean + 17.5 % triticale + 2.5 % CMV.

Blood assays

- **Parameters :**
  - ✓ **Red blood cell count (RC),**
  - ✓ **White blood cell counts (BC),**
  - ✓ **Haemoglobin (Hb),**
  - ✓ **Hemotogrite (Ht),**
  - ✓ **Mean corpuscular volume (MCV),**
  - ✓ **Mean corpuscular haemoglobin (MCH),**
  - ✓ **Mean corpuscular haemoglobin concentration (MCHC) ,**
  - ✓ **Platelet (Plq).**

- **BC -280 Vet blood analyzer** (Mindray, 2009; ENMV-Tunisia).

Rumen fermentation

50 ml of rumen fluid (before feeding, 3 and 6 hours post feeding) via stomach tube (Ogimoto and Imai, 1981).

- **Ruminal-pH (pHmeter , Omega ®)**
- **Osmolarity (Osmometer, Löser Messtechnik, Germany, Quality Laboratory Analysis, CBBC, Tunisia)**

  1ml rumen+ 1 ml of 25% metaphosphoric acid → Centrifugation (2000rpm for 15 min at 4◦C)→ Lecture.
- **NH_3^+ concentration**

  50 ml of strained rumen liquor+ 1 ml of saturated mercuric chloride → Centrifugation (1000rpm for 10 min) →Spectrophotometer lecture (ɣ= 540 nm).
- **Na+ concentration**

  Atomic Absorption spectrometry (I ɣ= 589 , NGREF, Tunisia).
- **Protozoa enumeration**

  1ml rumen fluid + 1ml methyl green-formalin solution .
- **Quantification and generic composition**
- 1 ml counting chamber (Hausser Scientific Partnership, Horsham, PA; cat. No. 3800), following the procedures described by Dehority (1993).

Statistical analysis

- **Hematological data were analyzed using the effect of Water quality according to the following model:**

$$Y_{ij} = U + W_i + e_{ij}$$

- **Rumen fermentation data were analyzed using the effect of Origin, Water quality and interaction between this effects according to the following model:**

$$Y_{ijk} = U + O_i + W_j + e_{ijk}$$

Y : observation
U : common mean
O : origin (C-ewes or S-ewes)
W : water quality (C or S level)
e : randomly error

- **Proc GLM procedure (SAS, 2000) .**
- **LS-means tests were applied for means comparison.**

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RESULTS AND DISCUSSION

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Table1 : Effect of water salinity in hematological parameters of Barbarine kids

Parameters	C-Kids	S-Kids
Red blood cell count (10^9/L)	14.29	12.12
White blood cell counts (10^{12}/L)	12.08	11.21
Haemoglobin (g/L)	10.67[a]	10.07[b]
Hemotogrite (%)	45.16[a]	43.03[a]
Mean corpuscular volume (µL)	42.69	38.49
Mean corpuscular haemoglobin (pg)	8.79	8.92
Mean corpuscular haemoglobin concentration (g/L)	23.58	23.37
Platelet (10^9/L)	243.56	251.89

Accumulation of extracellular fluid

Weeth et *al.*, (1960); Omar, (1969); Toha et *al.*, (1978); Kawashti et *al.*, (1983); Hussein et *al.*, (1990); Ibrahim, (1995); Katting et *al.*, (1992); Badawy, (1999)…

- ✓ **Weeth and Haverland (1961)**

  Ewes feeding 13.1% of NaCl.

- ✓ **Chicco et *al.*, (1971)**

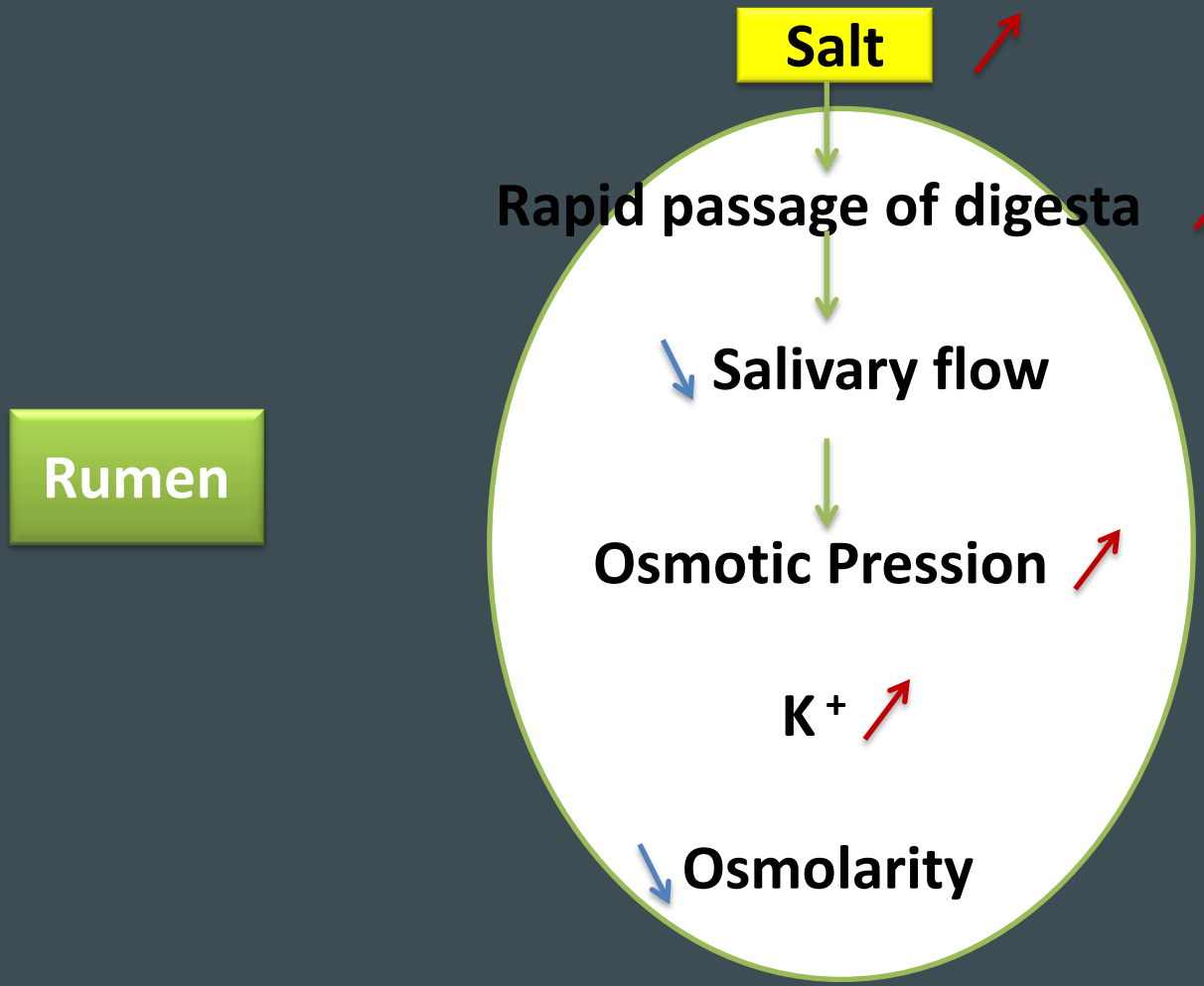
  Self-feeding a 30% salt supplement to beef cattle grazing.

- ✓ **Gill et *al.*, (1994)**

  Five different feeding regimes of *Sudex* and *Atriplex* alone and with different proportions.

Table2 : Long-term ruminal fermentaion adaptation in Barbarine lambs

Parameters	Hour	C-ewes		S-ewes		ES	*Valeur P*		
		CC-Lambs	CS-Lambs	SC-Lambs	SS-Lambs		O	W	O x W
pH									
	0	5.91	5.64	6.23	5.40	0.12	ns	ns	ns
	3	5.78	5.64	5.92	5.78	0.1	ns	ns	ns
	6	6.02	6.22	6.08	5.80	0.1	ns	ns	ns
Osmolarity (mosm/kg H_2O)									
	0	1273.40	1278.80	655.20	179.20	21.7	***	***	ns
	3	748.60	745.40	222.40	213.40	33.26	***	***	ns
	6	664.60	211.60	160.40	172.20	23.5	***	***	ns
NH_3^+ (mg/dl)									
	0	8.99	7.12	9.39	7.27	1.1	ns	ns	ns
	3	16.08	12.88	16.62	15.40	1.89	ns	ns	ns
	6	16.07	12.87	16.61	15.39	1.89	ns	ns	ns
Na+ (mg/100g)									
	0	34.44	29.82	42.18	33.48	5.31	ns	ns	ns
	3	30.78	30.30	31.08	31.20	1.37	ns	ns	ns
	6	27.24	31.98	27.66	30.66	1.63	ns	ns	ns



Von Engelhardt (1969); Potter et *al.,(*1972); Rogers, et *al.,* (1979); Croom et *al.,* (1982 Warner & Stacy (1965, 1972, 1975)

Table3 : Long-term ruminal fermentaion adaptation in Barbarine lambs

Parameters	Hour	C-ewes		S-ewes		ES	*Valeur P*		
		CC-Lambs	CS-Lambs	SC-Lambs	SS-Lambs		O	W	O x W
Protozoa (10^5/ml)									
	0	34.00	28.20	27.60	29.60	1.06	ns	ns	ns
	3	44.00	28.40	30.80	35.60	1.11	ns	ns	ns
	6	70.40	29.60	35.60	42.00	1.31	ns	ns	ns
Endiplodium (10^5/ml)									
	0	25.20	22.00	19.20	19.60	1.7	ns	ns	ns
	3	22.00	19.60	18.80	21.60	1.59	ns	ns	ns
	6	41.60	18.00	21.20	24.80	1.72	ns	ns	ns
Epidimium (10^5/ml)									
	0	8.40	6.00	8.40	10.00	1.42	ns	ns	ns
	3	20.40	8.40	11.60	14.00	1.62	ns	ns	ns
	6	28.40	10.00	14.40	17.20	1.64	ns	ns	ns
Polyplastium (10^5/ml)									
	0	0.40	0.20	0.00	0.00	0.44	ns	ns	ns
	3	1.60	0.40	0.40	0.00	0.56	ns	ns	ns
	6	0.40	1.60	0.00	0.00	0.42	ns	ns	ns

- Kroger and Carroll (1964) reported that the Infusion of high salt levels into the rumen has not affected *in vitro* cellulose digestion or rumen motility over a period of several days.

- Kattnig et *al.* (1992) did not show any change in the ruminal fluid kinetics, on ruminal flow rate and rumen volume, fluid dilution rate, fluid turnover time in to Holstein steers drinking saline water (2.300 ppm TDS) .

- Attia-Ismail et *al.* (2008) to test the effect of salinity level drinking sea water prouved that neither ammonia nitrogen nor total volatile fatty acid production did not differ significantly due to salinity levels in sheep and goat .

Conclusion

- ✓ *Barbarine male lambs* can subsist drinking saline water containing 10 g/l of NaCl for relatively long period (270 days) without exhibiting harmful effects on health.
- ✓ Offspring born to ewes that drink high amounts of salt during pregnancy are programmed to have an altered Hb and Ht parameters and a decreased ruminal osmolarity.
- ✓ This adaptive response may be particularly useful to adapt the offspring to the salt stress.
- ✓ Overall, our data support previous findings in rats and sheep that drinking high salt water during pregnancy can change the physiology of the offspring.

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THANKS FOR YOUR ATTENTION