Identification of uterine ionic transport proteins involved in providing the mineral precursors for eggshell formation in hens.

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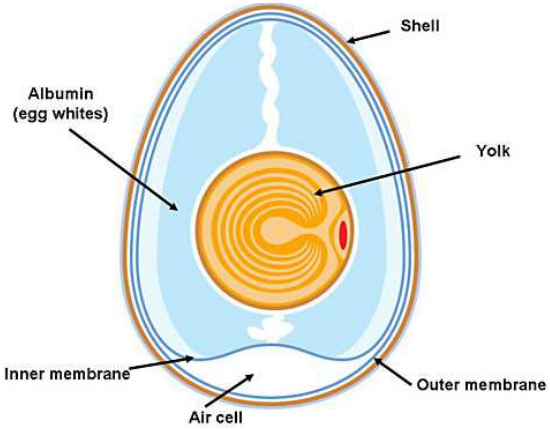
Introduction

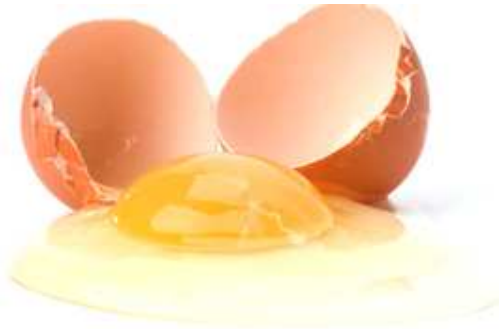
The Egg: Oocyte surrounded by nutritional reserves from yolk and egg white.



Container for extra-uterine development of the embryo

➢Well-balanced source of ingredients

Basic food for human consumption



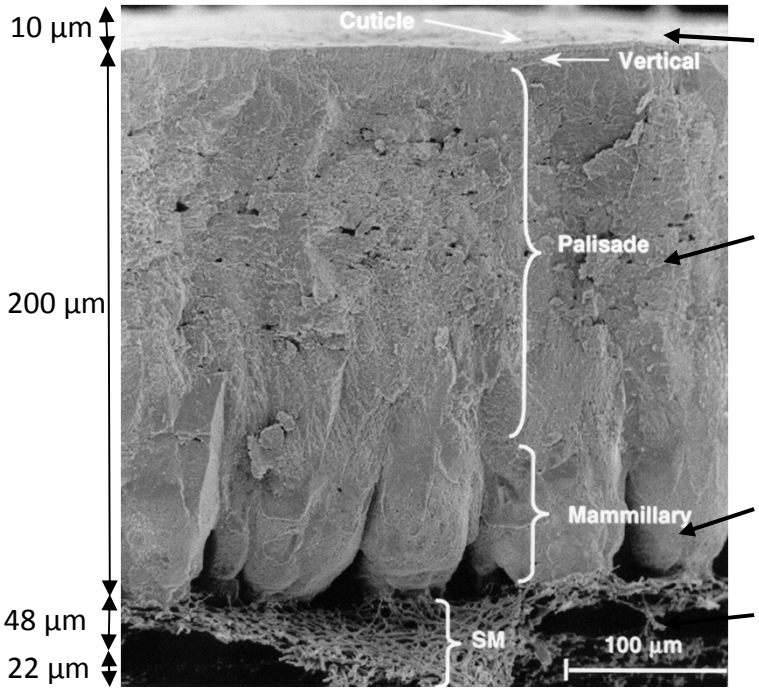
Maintain a sterile environment

→ The Eggshell: physical egg defense

Chicken eggshell

The eggshell strength : physical protection of the egg.

Mechanical properties : 0,3 mm / 3Kg



cuticule

palissade layer

Mammillary knobs

Eggshell membranes

Eggshell cross section, SEM

(Nys, *et al.*, 2001)

Components :

95% minerals (calcium carbonate)

3,3% organic matrix

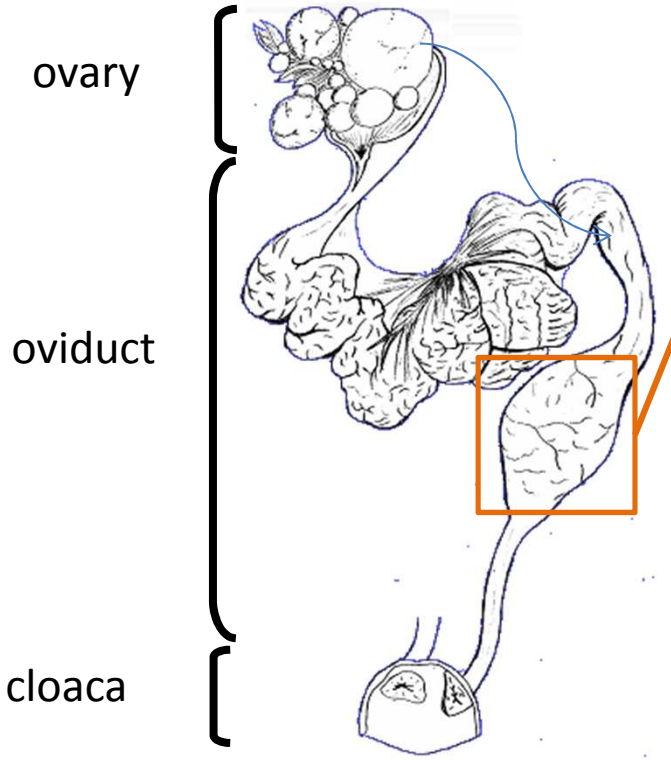
1,7% water

Mechanical properties:

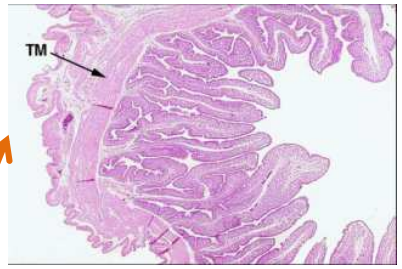
- Amount of minerals
- Control of the calcification process by the organic matrix

Eggshell formation

Hen reproductive organ

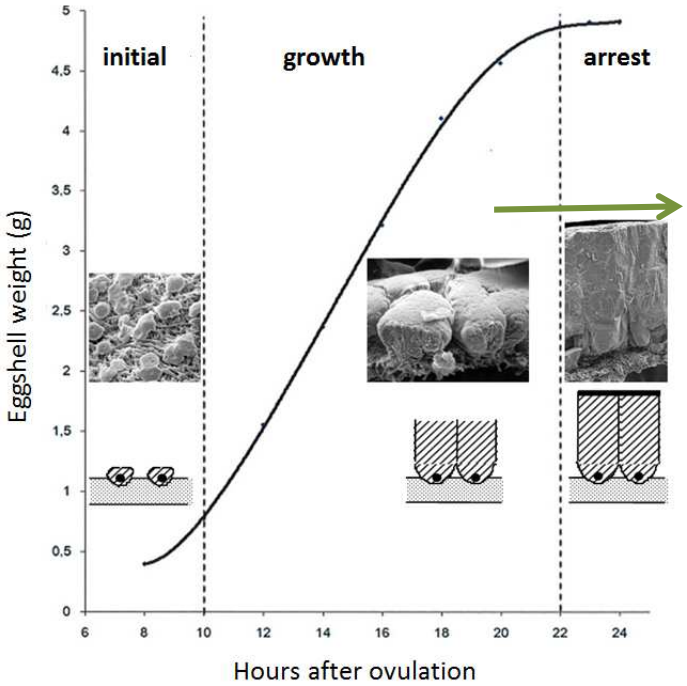


Eggshell biomineralization



- **Calcification in uterine fluid**
  Acellular process
- **Uterine epithelium gene expression**
  Mineral supplies
  Protein secretion (organic matrix)

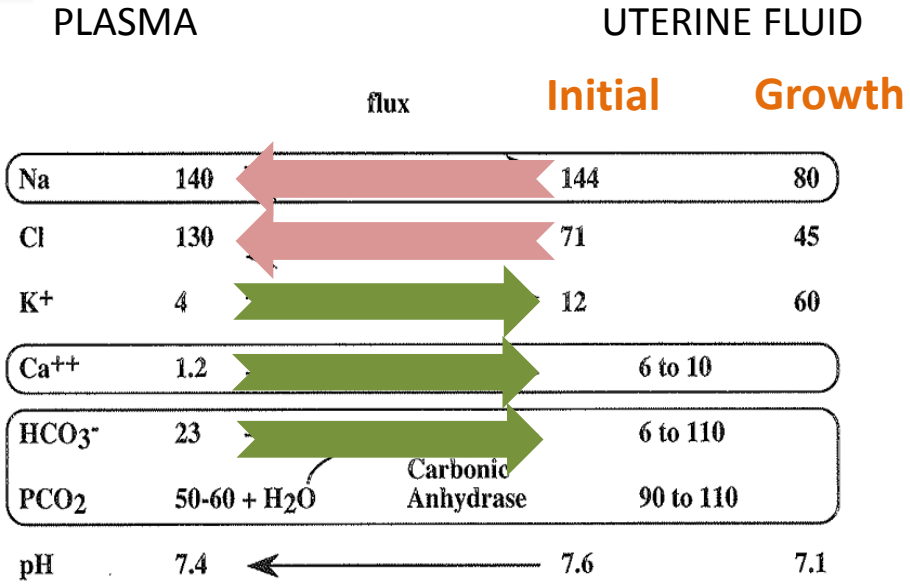
Eggshell calcification stages



Active growth phase:
5 g of eggshell in only 12 hours

Eggshell mineral supplies

Uterine ion concentration (adapted from Nys, 1999)



Calcium is not stored by the uterus

→ **Intensive calcium metabolism: total renewal of blood calcium every 12 minutes…**

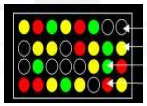
Objectives

→ **Identify all the protein transporters involved in the supply of mineral precursors for the formation of the shell ?**

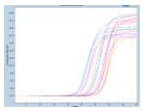
Experimental approaches

Gene expression:

Microarrays



Real time PCR



Animal models:

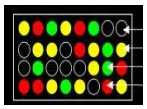
a. Uterus *vs* other tissues
b. Uterus presence *vs* absence calcification

Data integration:

Bioinformatic analysis

Jonchère *et al. BMC Genomics* 2010, **11**:57
http://www.biomedcentral.com/1471-2164/11/57

BMC Genomics

a. 

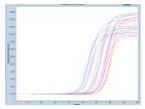
RESEARCH ARTICLE Open Access

Gene expression profiling to identify eggshell proteins involved in physical defense of the chicken egg

Vincent Jonchère[1], Sophie Réhault-Godbert[1], Christelle Hennequet-Antier[1], Cédric Cabau[1], Vonick Sibut[1,3], Larry A Cogburn[2], Yves Nys[1], Joël Gautron[1*]

Jonchère *et al. BMC Physiology* 2012, **12**:10
http://www.biomedcentral.com/1472-6793/12/10

BMC Physiology

a. 

b.

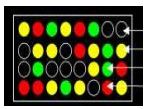
RESEARCH ARTICLE Open Access

Identification of uterine ion transporters for mineralisation precursors of the avian eggshell

Vincent Jonchère, Aurélien Brionne, Joël Gautron and Yves Nys*

Brionne *et al. BMC Genomics* 2014, **15**:220
http://www.biomedcentral.com/1471-2164/15/220

BMC Genomics

b. 

RESEARCH ARTICLE Open Access

Hen uterine gene expression profiling during eggshell formation reveals putative proteins involved in the supply of minerals or in the shell mineralization process

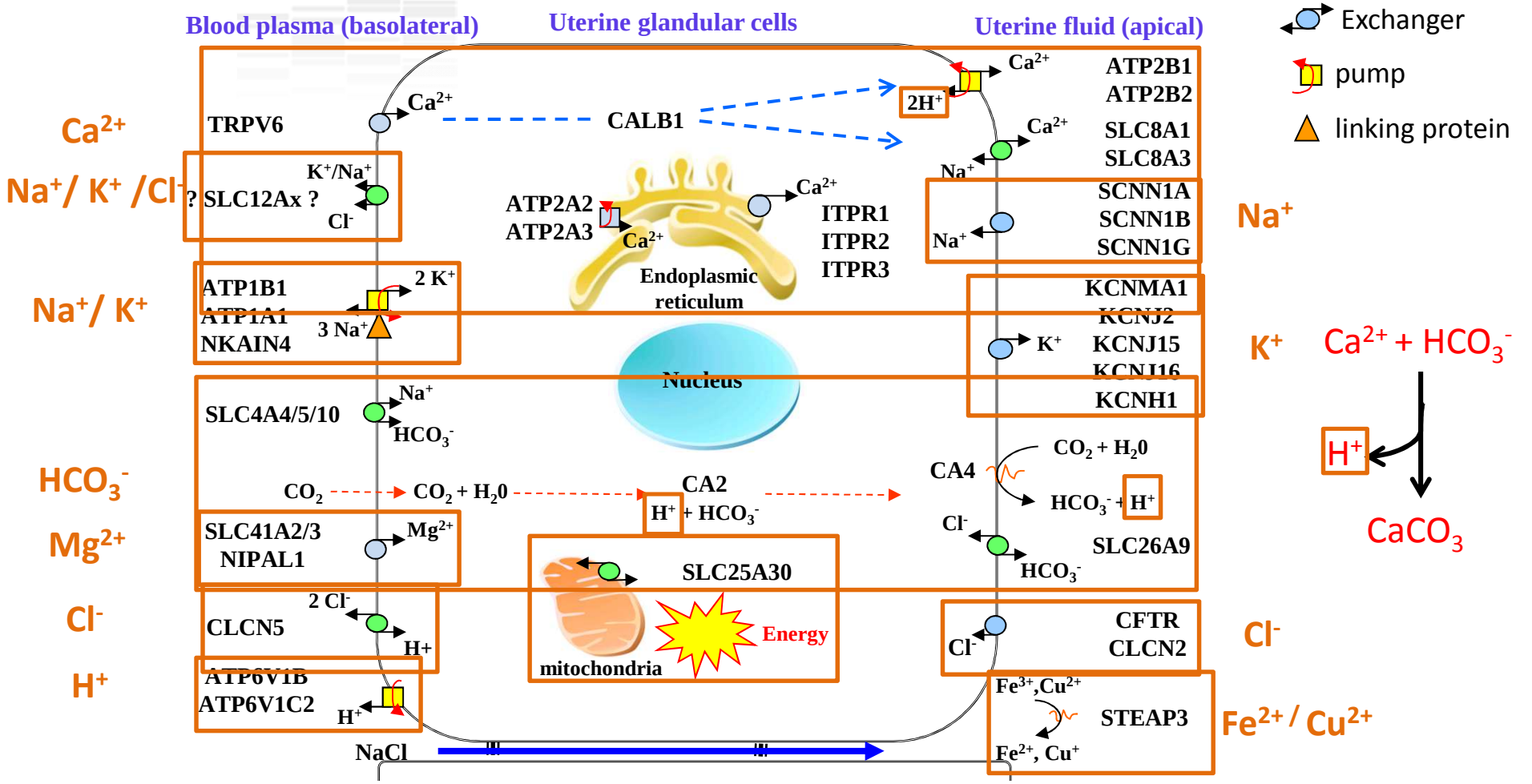
Aurélien Brionne, Yves Nys, Christelle Hennequet-Antier and Joël Gautron*

General model describing all the uterine ion transporters during eggshell calcification

- Co-transporter
- Channel
- Exchanger
- pump
- linking protein

General model of uterine ion transporters

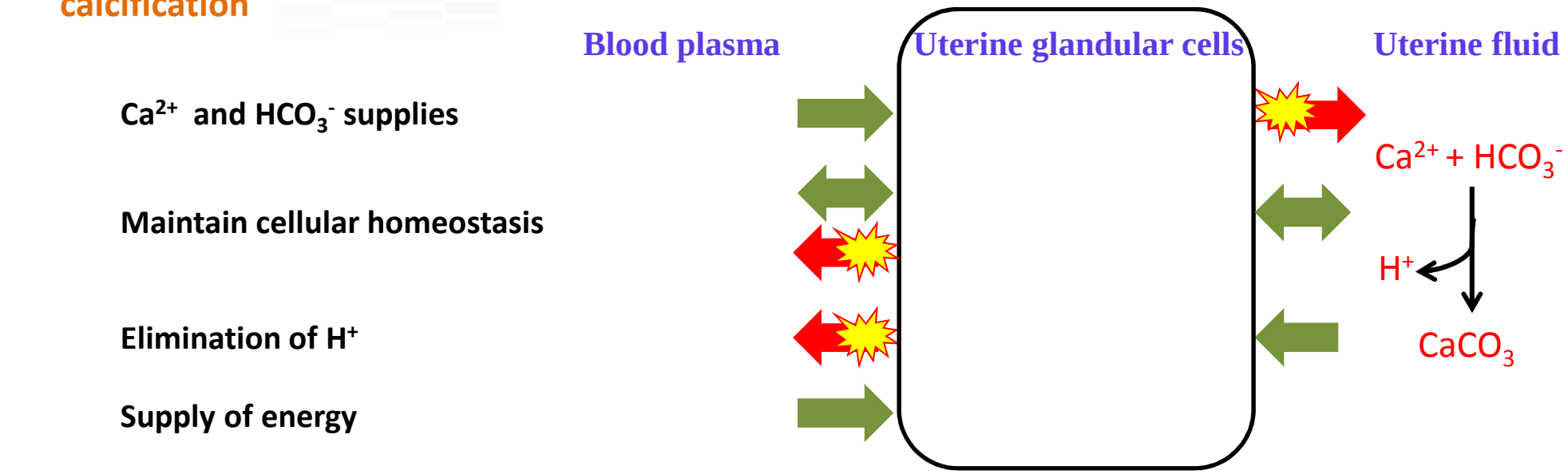
Cellular [illegible] homeostasis



Jonchère, *et al., BMC physiology*, 2012; Brionne, *et al., BMC Genomics*, 2014

Conclusion

→ Coherent model describing ion transporters in the uterine glandular cells during eggshell calcification



Qualitative study:

→ Further studies are needed to establish their relative contribution.

→ Identified transporters: Tools for studying interactions and regulations of ions transfer.

Potential methods: drug inhibitors, dietary deficiency of calcium, ovulatory cycle,…

Acknowledgements

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