



VetAgro Sup

Nutritional flexibility of Charolais Cows

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EAAP, Stavanger, Norway, 29th August – 2nd September 2011

BACKGROUND

Beef cattle systems

- Maximisation of fodder self sufficiency
- Feeding management more economical and sustainable



Winter undernutrition is commonly used

French dietary guidelines for cattle (INRA 2007)

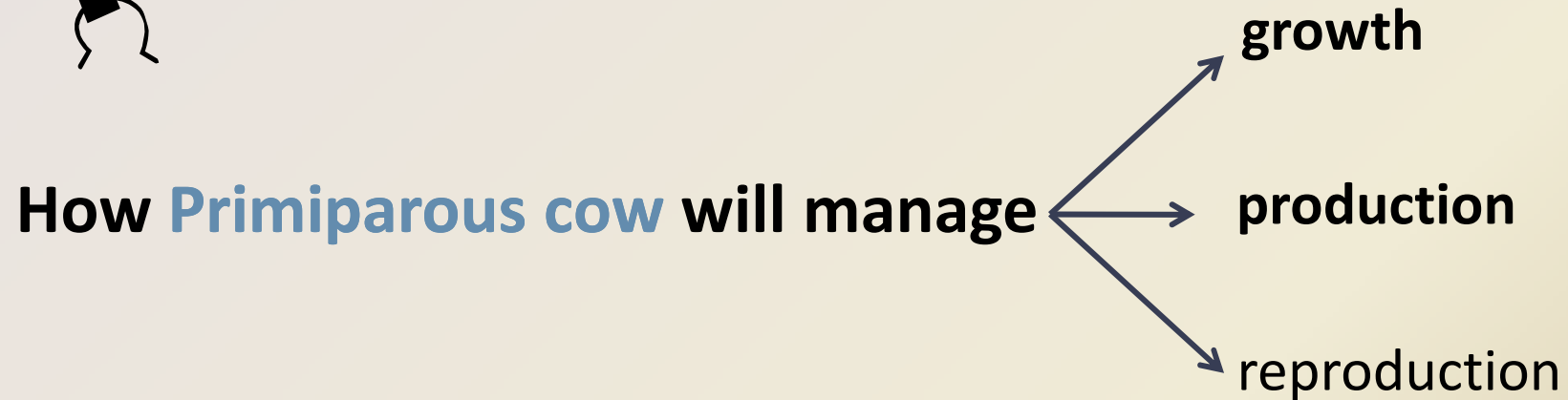
- Cows can be fed under their requirements
- *Abilities of cows to mobilize their body reserves, especially adipose tissues*

* Data largely refer to **multiparous cows**

Background



Under feeding restriction conditions



Post-partum adaptive response of
primiparous and **multiparous** cows
to a nutritional challenge ?

Experimental Scheme

14 Multiparous

5 ± 1,4 years old
798 ± 26 kg
BCS : 2,4 ± 0,3

14 Primiparous

3 ± 0,1 years old
748 ± 38 kg
BCS: 2,4 ± 0,1

CALVING

INDOOR (110 days)

High

Low

High

Low



Hay/ Concentrate: 70/30

90/10

70/30

90/10

88 MJ/d

59 MJ/d

87 MJ/d

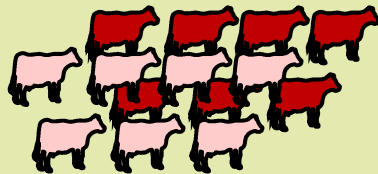
60 MJ/d

Mid-May

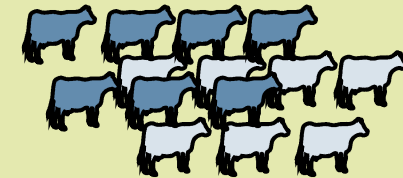
H/L difference
29 MJ/d

PASTURE (63 days)

H/L difference
27 MJ/d



35 ares per cow/calf pair



Non-limited permanent pasture with high nutritive quality

End of July

Measurements

CALVING



Adipose tissue biopsy
→adipose cells Ø
(Garcia *et al.*, 2007)

Live Weight (LW)

Body Condition Score (Agabriel *et al.*, 1986)

NEFA concentrations

- Intake

Nutrient value determination

- Milk production (Le Neindre, 1973)

Body mass change
⇔adipose mass

→ fat-free mass

→ Calculated energy balance

INDOOR
(110 days)

Mid-May



Adipose tissue biopsy
→adipose cells Ø

Live Weight

Body Condition Score

NEFA concentrations

- Estimated intake

Estimated value of pasture

- Milk production

Body mass change
⇔adipose mass

→ fat-free mass

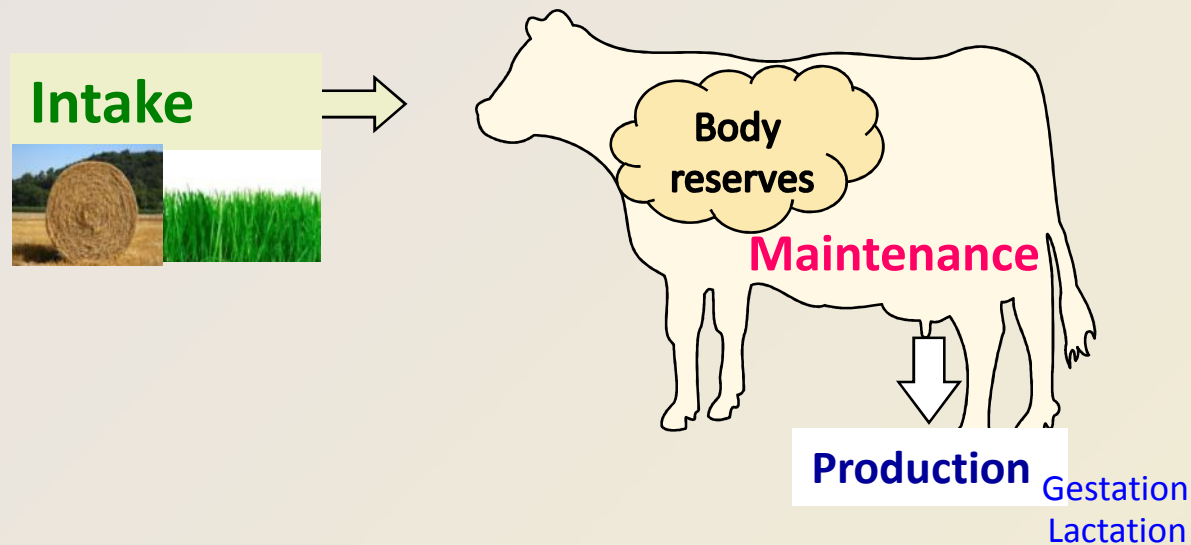
→ Estimated energy balance

End of July

Adipose tissue biopsy
→adipose cells Ø

PASTURE
(63 days)

Estimation of Energy available for maintenance (E_m)



$$E_{\text{maintenance}} \text{ (MJ)} = \text{Intake} - E_{\text{production}} - E_{\text{stored (or mobilized)}}$$

Hypothesis: No difference in nutritive values according to feed level

$E_{\text{milk}} = 3.2 \text{ MJ/kg}$
 $K_{\text{tissues}} \rightarrow \text{milk} = 0.8$

$\Delta \text{ kcal tissue} = 9,37 \times \% \text{ lipids} + 5,48 \times \% \text{ proteins}$

$K_{\text{lipid deposit}} = 0,8$
 $K_{\text{protein deposit}} = 0,6$

INRA, 2007

E_m maintenance
theoretical value expressed in net energy of lactation MJ/d/kg^{0,75}

$$= 0.29 \text{ MJ/d/kg}^{0,75} + 10\% \text{ in stalls}$$

or + 20% at pasture

Results

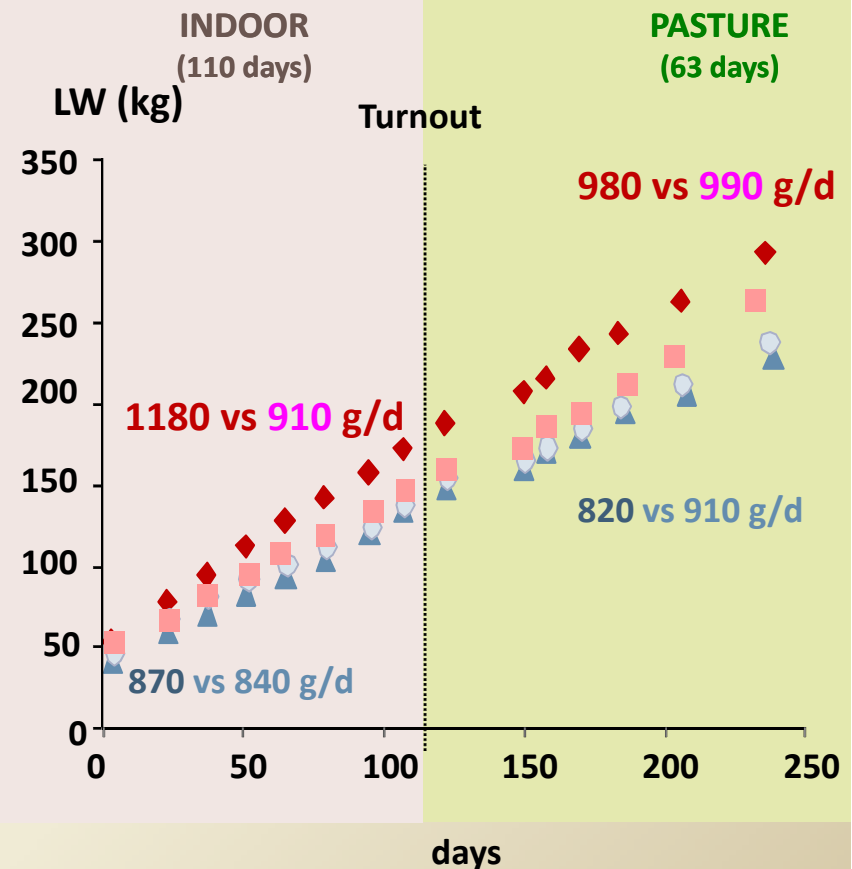
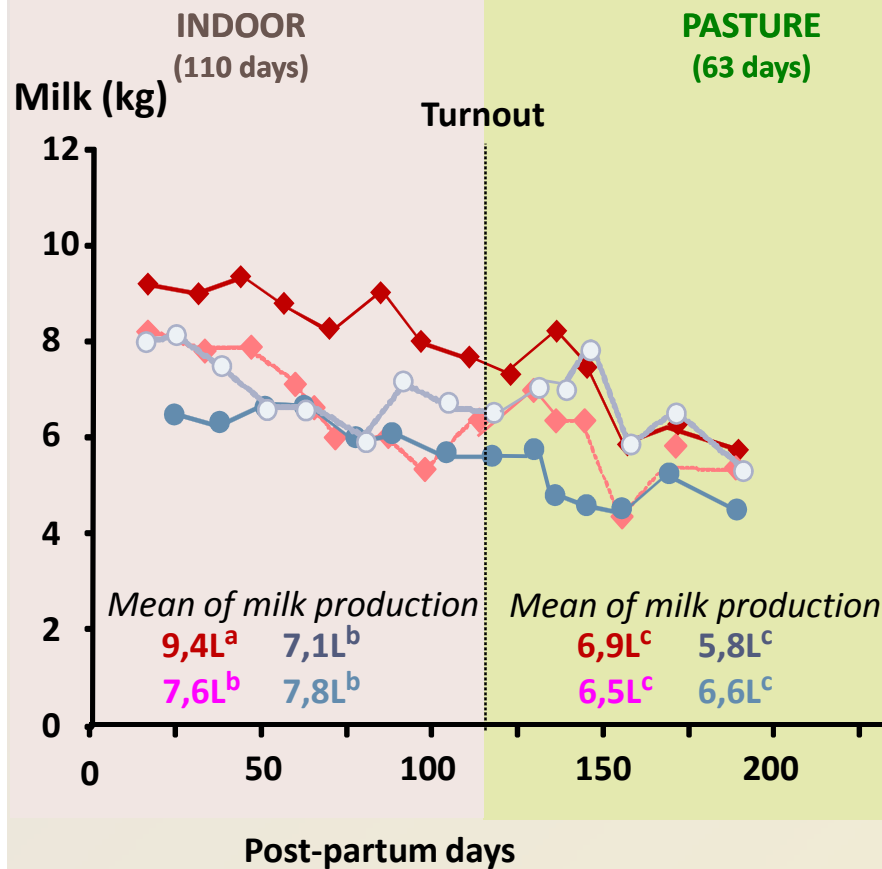
Function of production: Milk production and calves ' growth rate

 **MP High**

 **PP High**

 **MP Low**

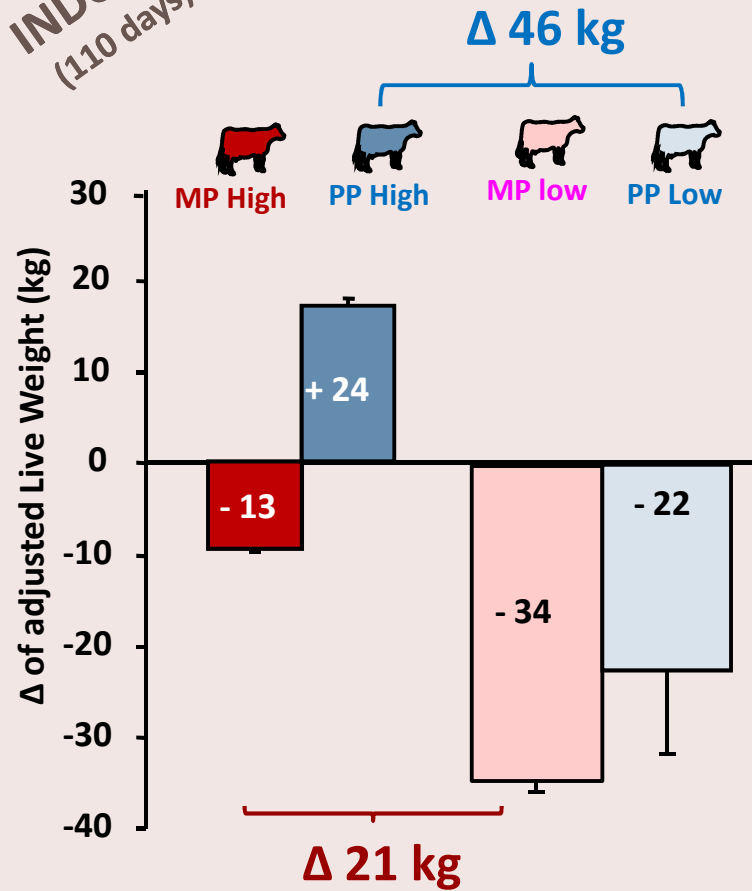
 **PP Low**



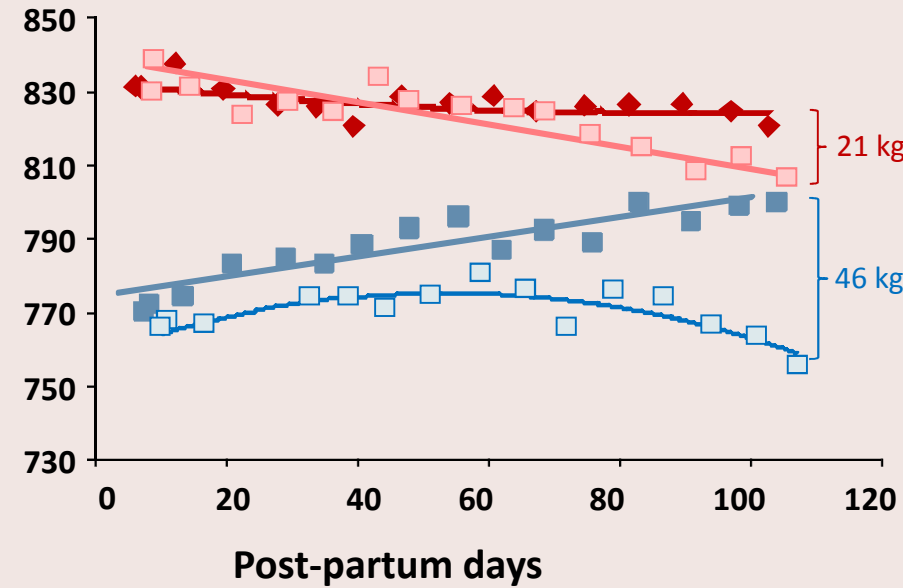
**Nutritional challenge doesn't affect
the function of production**

Dynamic body mass changes

INDOOR
(110 days)



Corrected LW



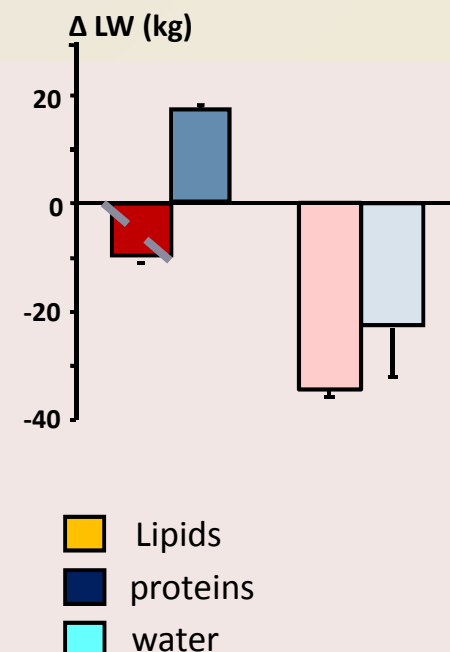
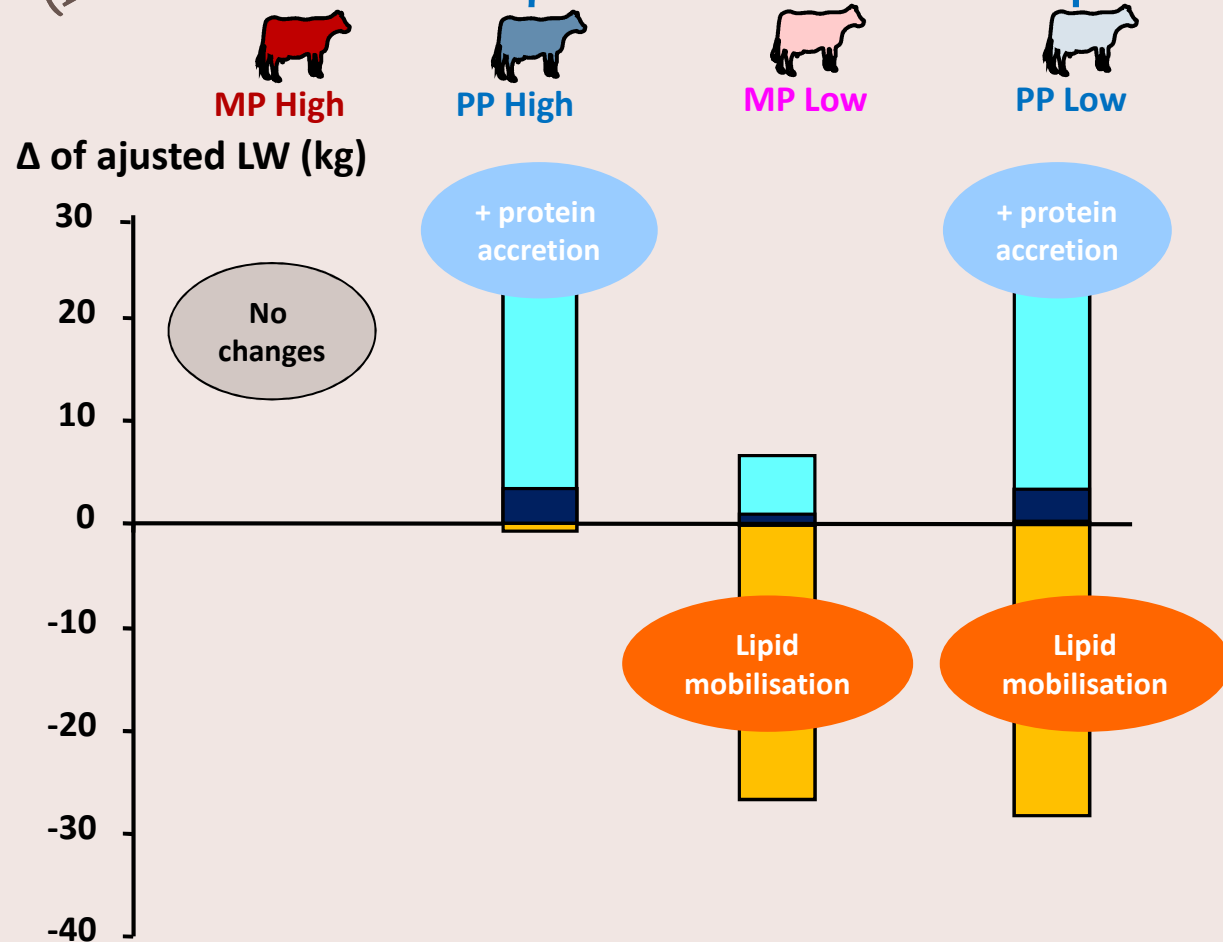
PP are more sensitive to the nutritional challenge than MP cows

Dynamic weight changes differ according to the parity

Body COMPOSITION changes

INDOOR
(110 days)

Increase in fat-free mass is similar



Nutritional challenge doesn't affect the potential of growth of primiparous cows

Energy partitioning during indoor period

Indoor
(110 jours)

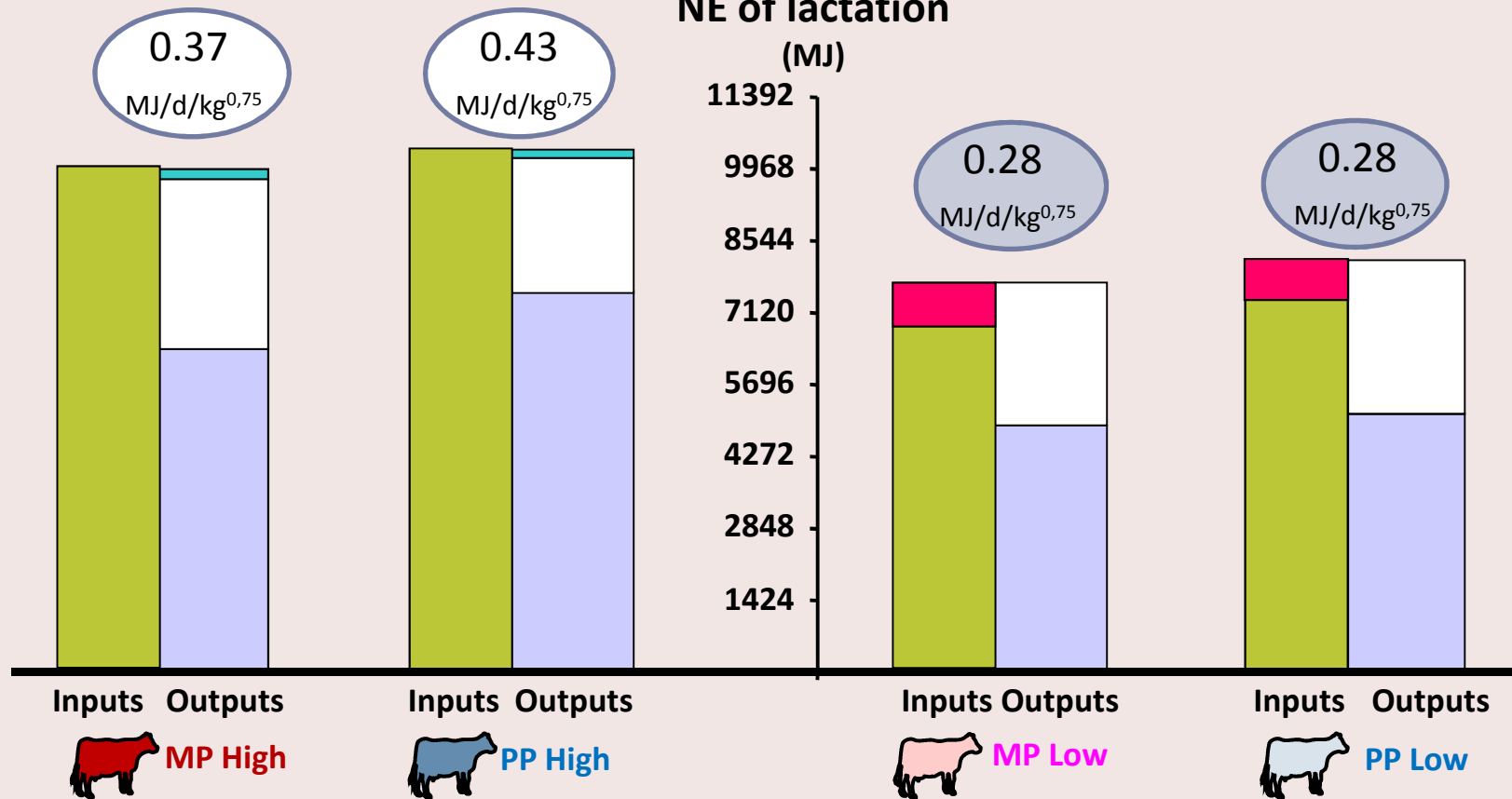
Theory: 0.32 MJ/d/kg^{0.75} (↔ 0.29+10%)

Inputs

- Feed E.
- E. mobilized from tissues

Outputs

- Maintenance E.
- Milk E.
- E. stored in tissues

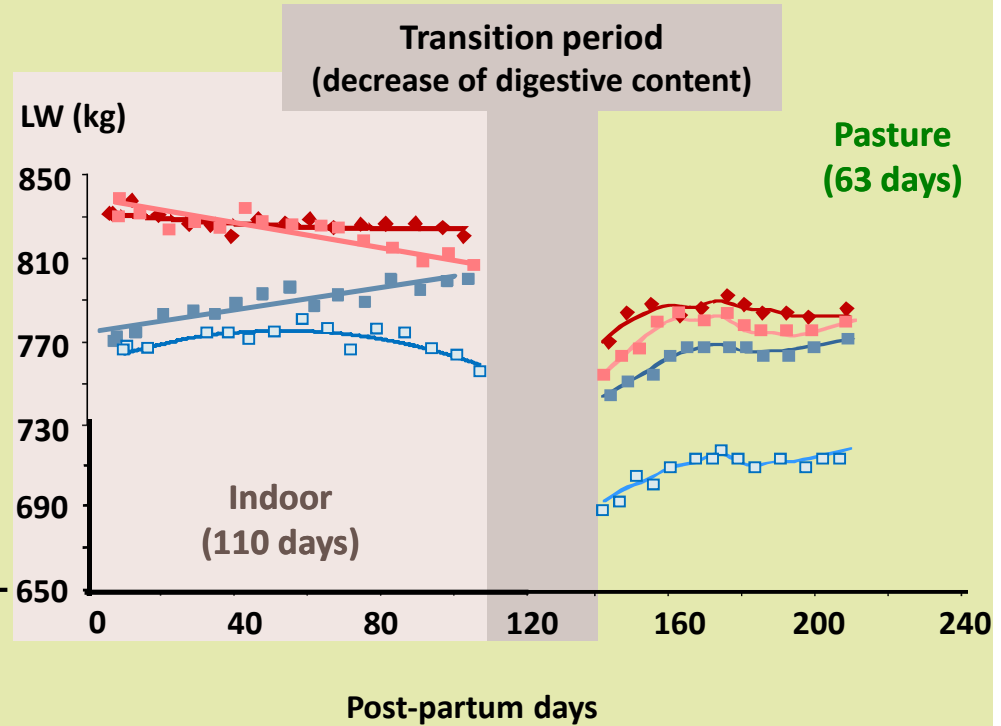
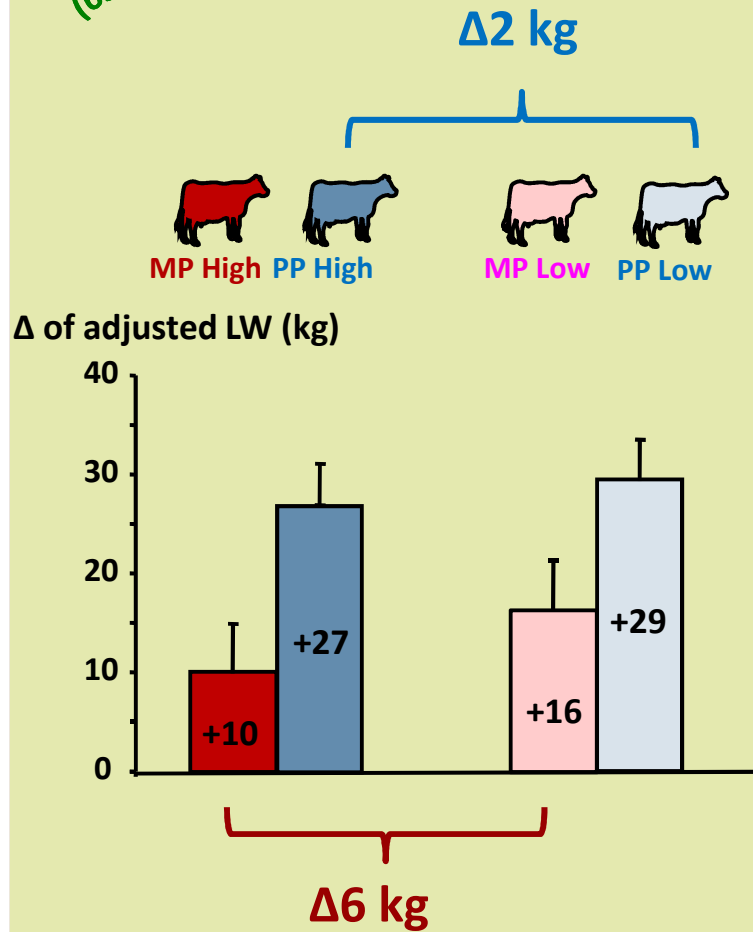


- Nutritional challenge induces a metabolic adaptation: ↘ 30% Eam (0.28 vs 0.40)
- Eam differs from the theoretical value

Dynamic body mass changes

Pasture
(63 days)

All cows grazed similar permanent pasture
No feed restriction

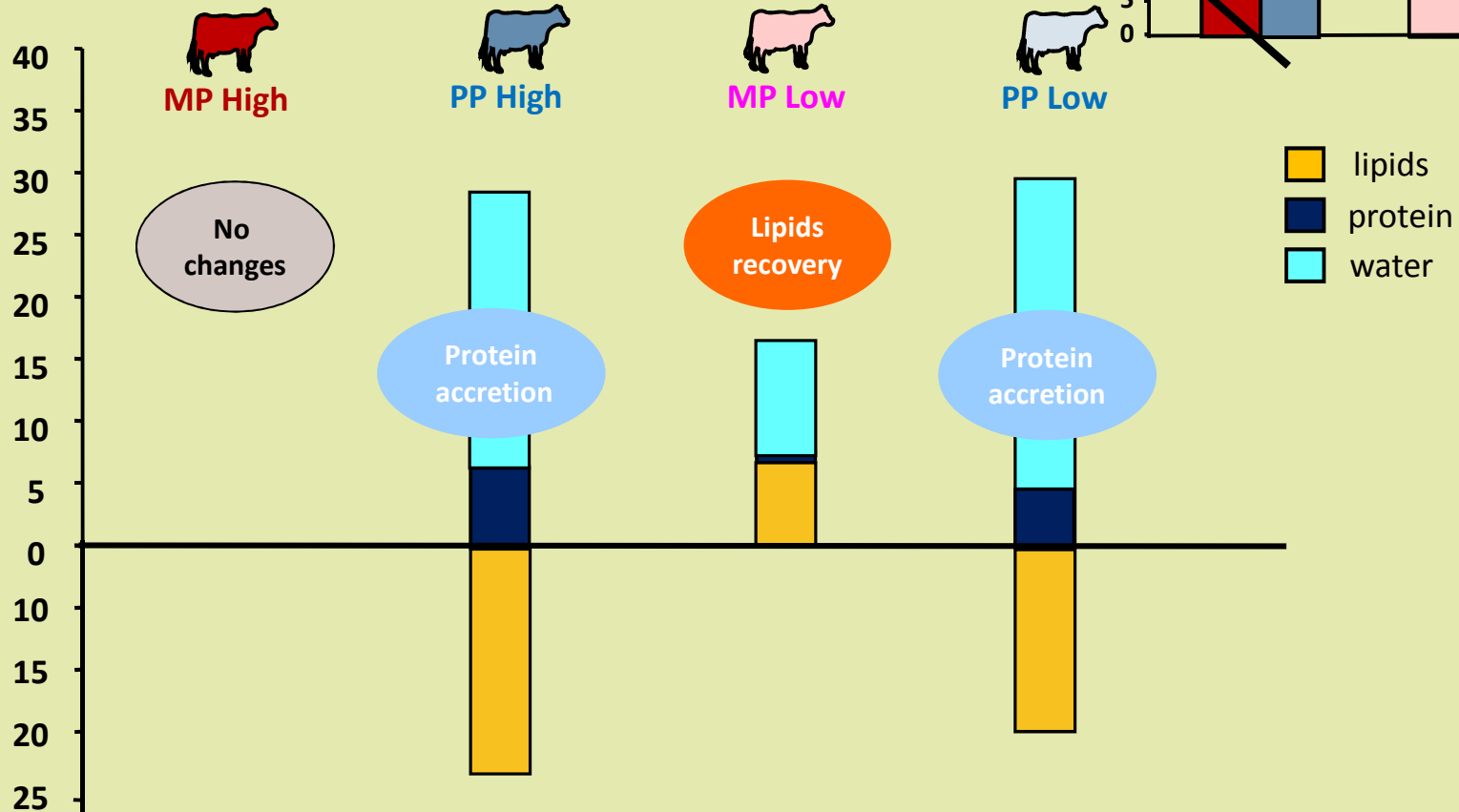


Body weight gain is observed in both PP and MP cows
Dynamic of body weight change is similar

Body composition changes

Pasture
(63 days)

Δ of adjusted LW (kg)



At pasture : MPL cows recover part of their body lipids
PP cows continue to grow

Energy partitioning at pasture

Pasture
(63 days)

Theory: $0.35 \text{ MJ/d/kg}^{0.75}$

Inputs

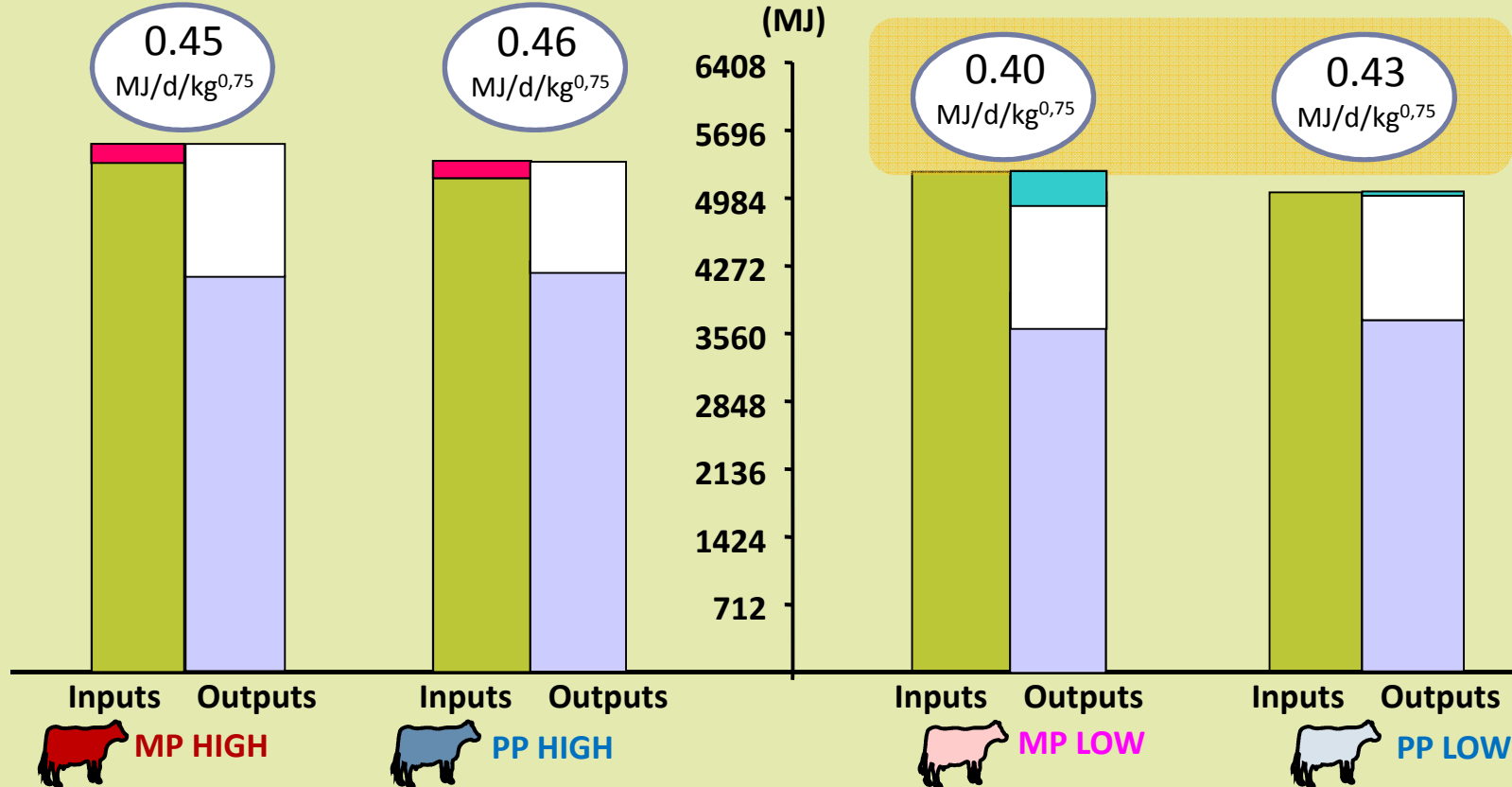
- Feed E.
- E. mobilized from tissues

Outputs

- Maintenance E.
- Milk E.
- E. stored in tissues

NE of lactation

(MJ)



- Eam is lower in winter feed restricted cows
→ retention of metabolic adaptation at least on the first part of pasture ?
- At pasture, Eam > theoretical value +20%

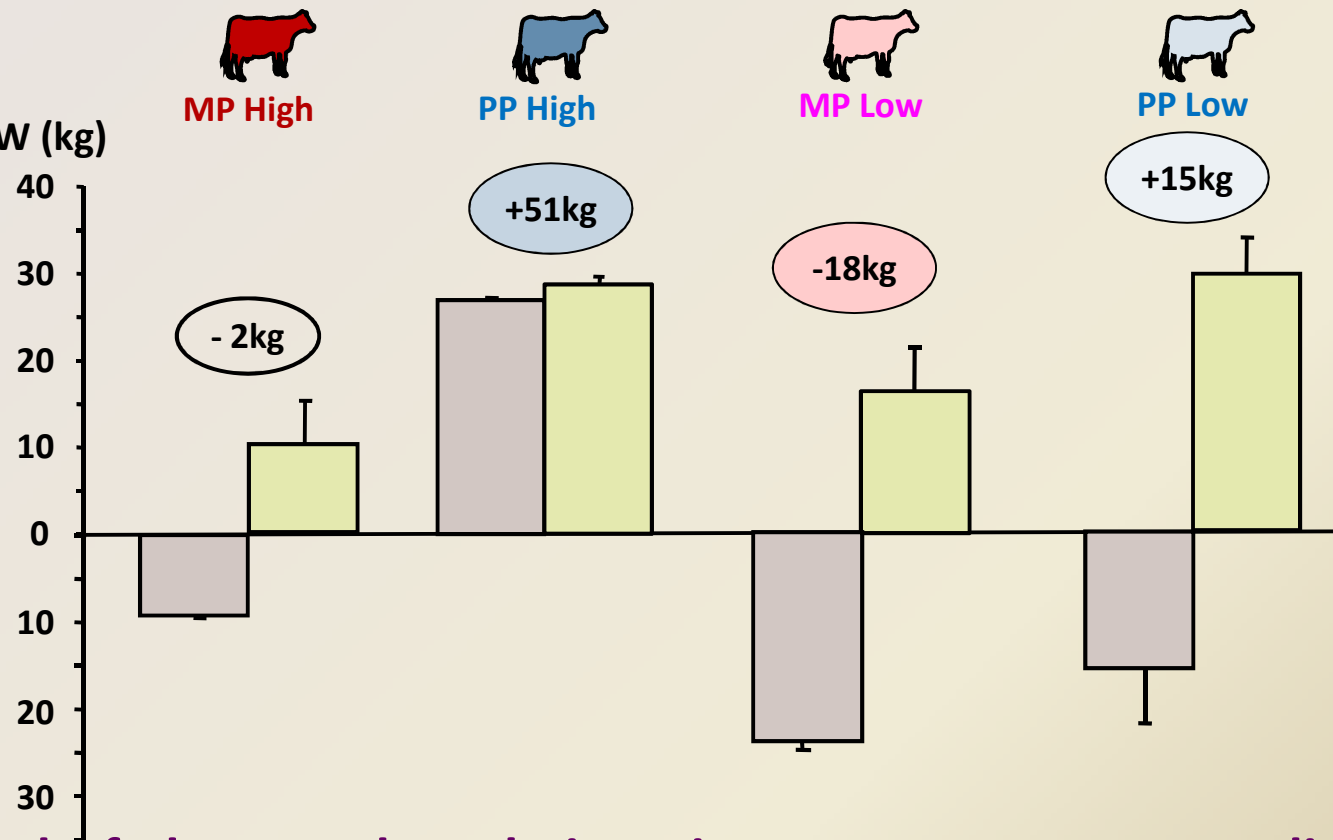
Conclusions

Conclusions

□ Indoor Δ LW

□ Pasture Δ LW

Δ of adjusted LW (kg)



⇒ Underfed cows adapt their maintenance energy expenditure
- Function of growth remains priority



What could be the adaptive response of primiparous cows ?

- younger, early maturing breed, minor body development and/or BCS
- longer feed restriction period (from housing to turnout)

Perspectives

⇒ Differences between observed and theoretical values



Improvement of energy for maintenance prediction

⇒ Take into account the energy balance changes
during the production cycle



**Development of a dynamic predictive model
of energy partitioning in beef cows**

Thank you...



Acknowledgements:

The staff of the experimental unit of Monts d'Auvergne

The staff of the laboratory of the Herbivore Research Unit