INRA Feeding System for Ruminants: a new « Red Book »

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with 20 co-authors from

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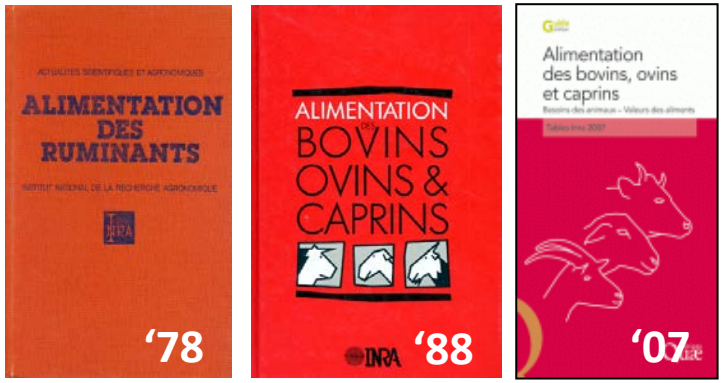
INRA Feeding System for Ruminants

- regularly updated during the last 4 decades
- widely used in France, in several European, African and South American countries
- robust but still have some limits

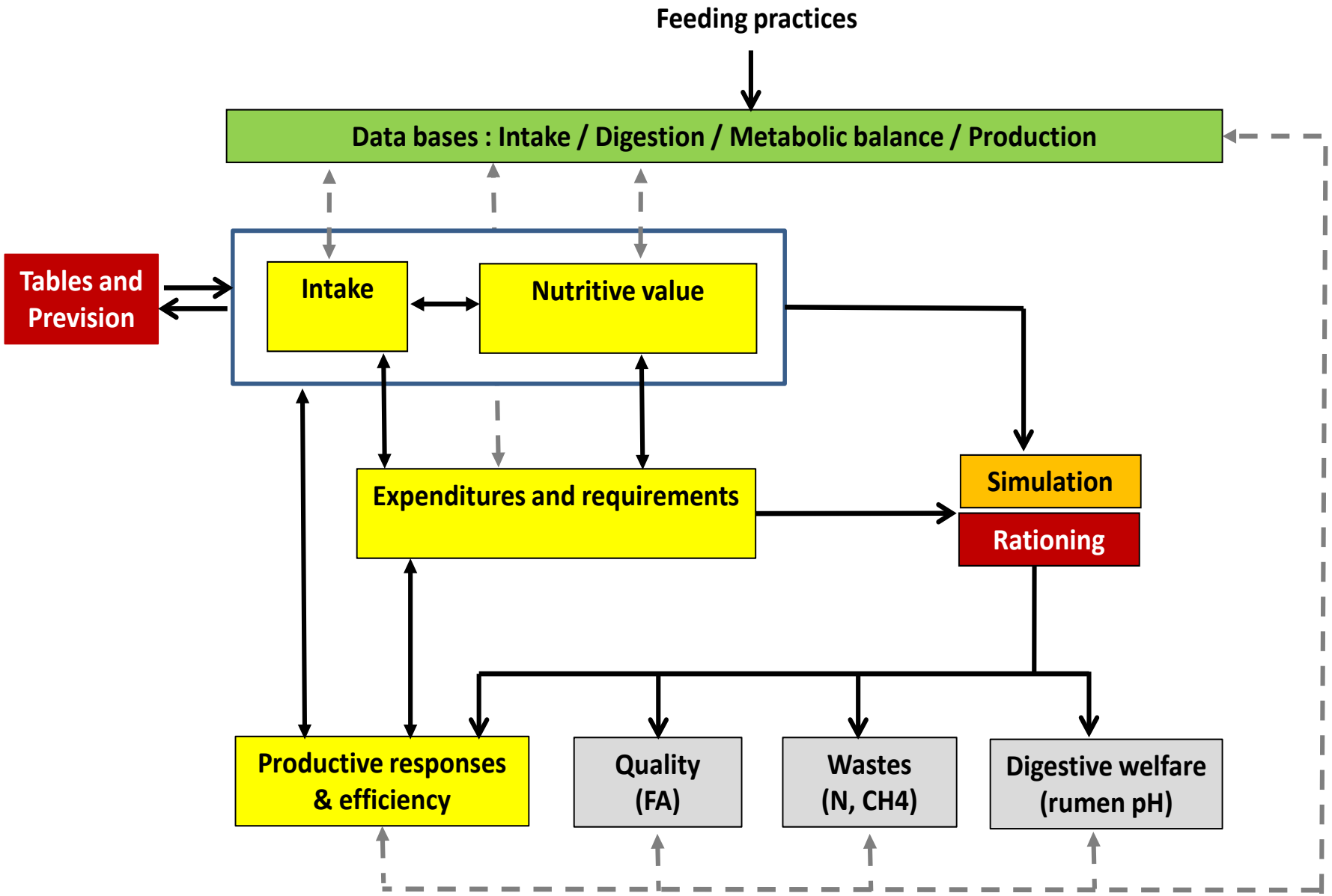


Challenges to address

- productive responses and feed conversion efficiency
- emissions to the environment
- product quality
- animal health
- case of « extreme » diets

- **→ The INRA « Systali » project** (2009→2016)
  - Dairy & Beef
  - Cattle, sheep and goats
  - Temperate, tropical and mediterranean contexts

Construction principles



→ interpretation of databases by homogenous and well traced statistical methods

→ evaluation of models (internal consistency, external evaluation, international comparisons)

→ evaluation of the whole system (consistency of coupling, large-scale simulations)

The content of the book

1. The dietary supply

- DM and water intake (inc. at grazing)
- Nutrient supply (NE, MP, AA, VFA, glucose, LCFA, minerals, vitamins

2. The animal's requirements and multiple responses to diets

Biological concepts and equations

Some illustrations in the present talk

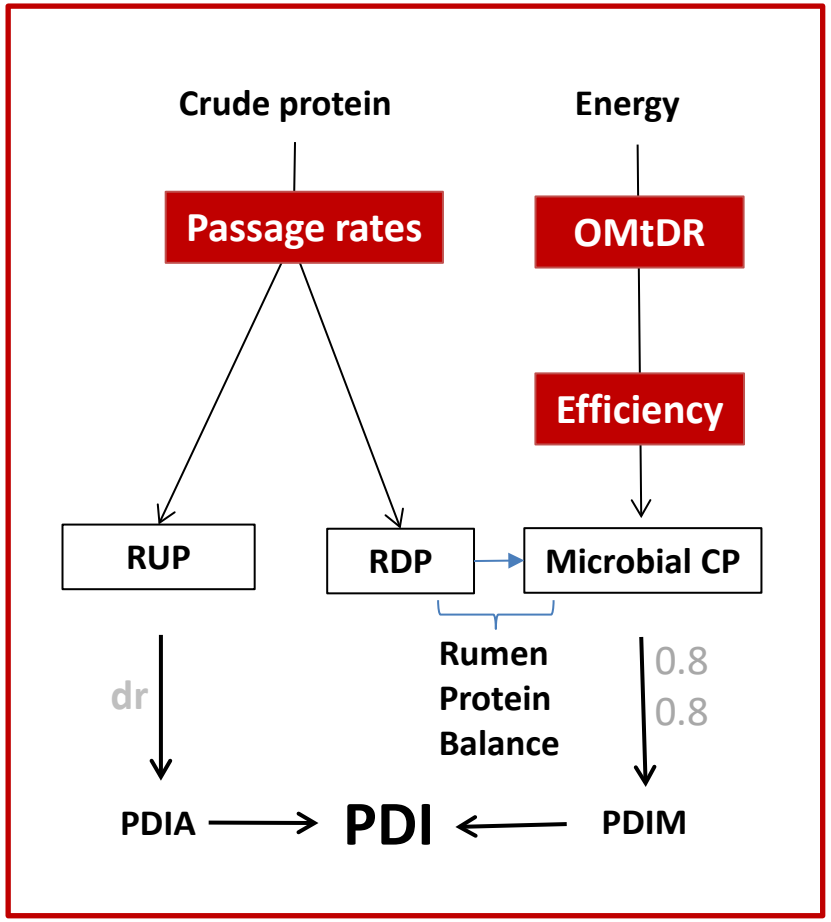
3. Practices for rationing

- diet calculation for a given performance objective
- prediction of the multiple responses of animal to diet changes

4. Feed values : reference methods, prevision, and tables

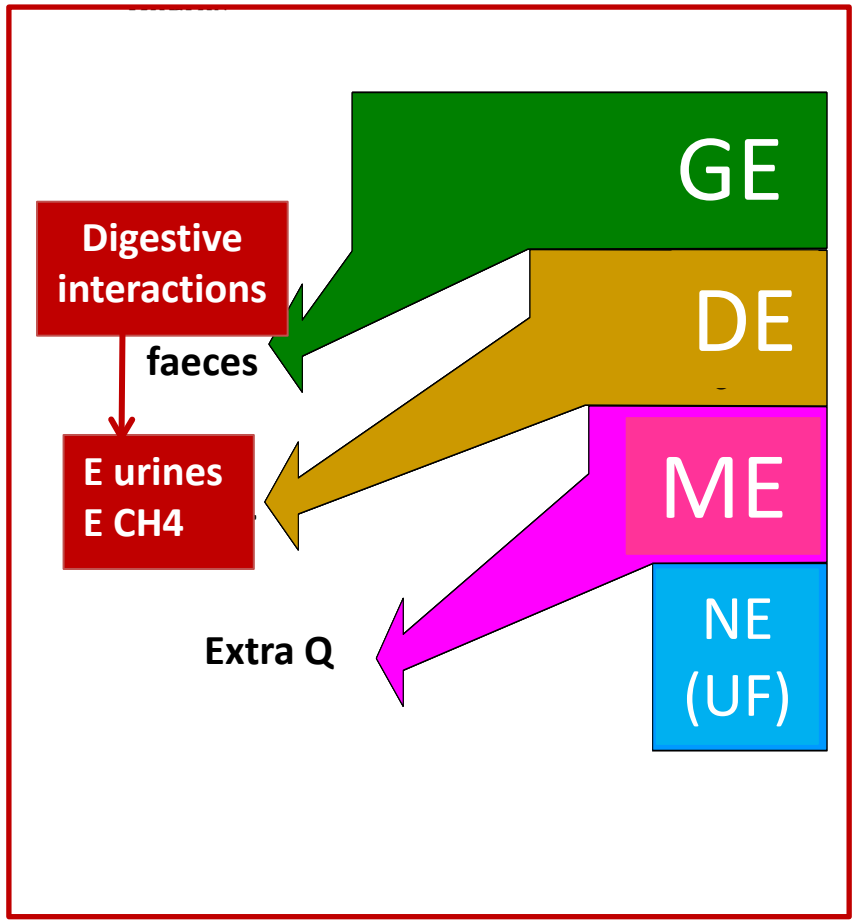
Practical use

Updating MP (PDI) & NE (UF) supply



Adapted from Vérité et al., 1987

Energy x Proteins interactions



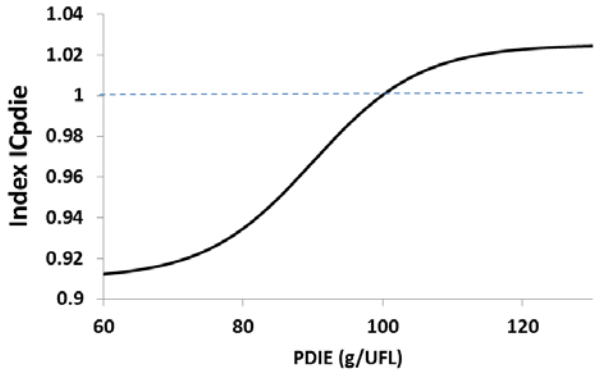
Adapted from Vermorel et al., 1988

Important updating that preserves the historical matrix
Accounts for effects of feeding level and interaction between feedstuffs
Feed value depends on the final ration
More precise (evolutive) prediction of energy and protein supplies (inc. individual nutrients)

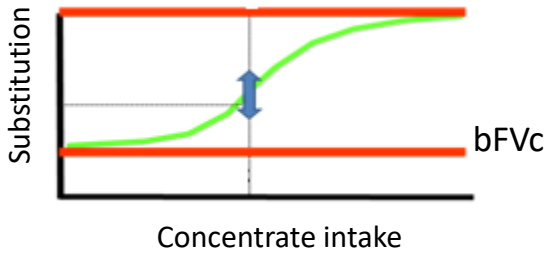
Updating the intake model (UE)

Basis of the model not modified but :

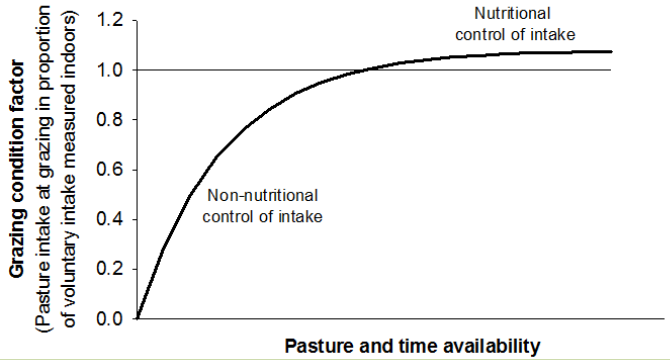
- **Effect of PDI level :**
  - modulation of the intake capacity with PDI/UFL



- **Fill effect of concentrates :**
  - basal fill value (bFVc)

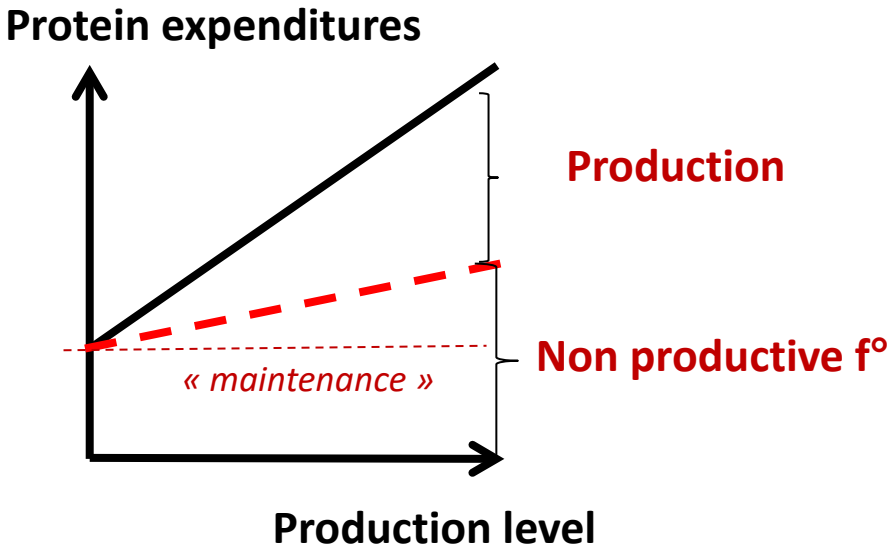


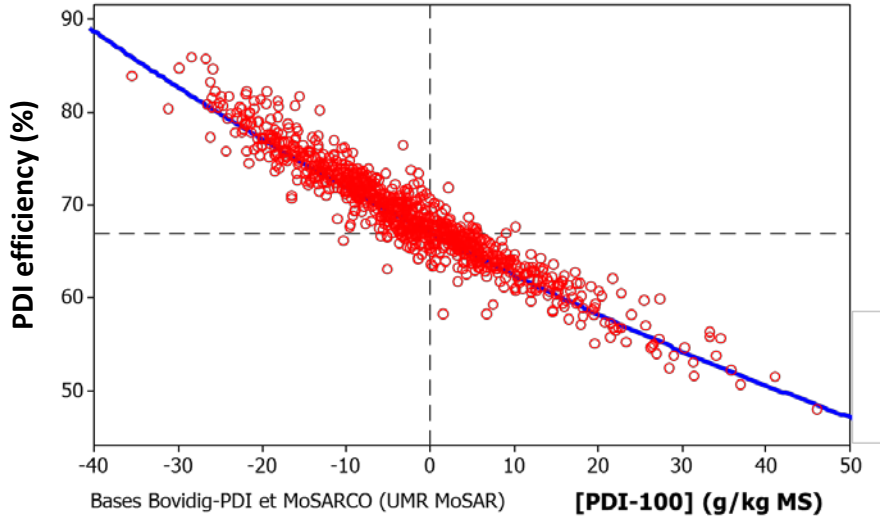
- **Effects of pasture and time availability** (rotational and set-stocking grazing)
  - Grazing condition factors



From Vérité et Delaby 2000;
Faverdin et al 2015; Delagarde et al, 2011

Updating protein expenditures and PDI efficiency





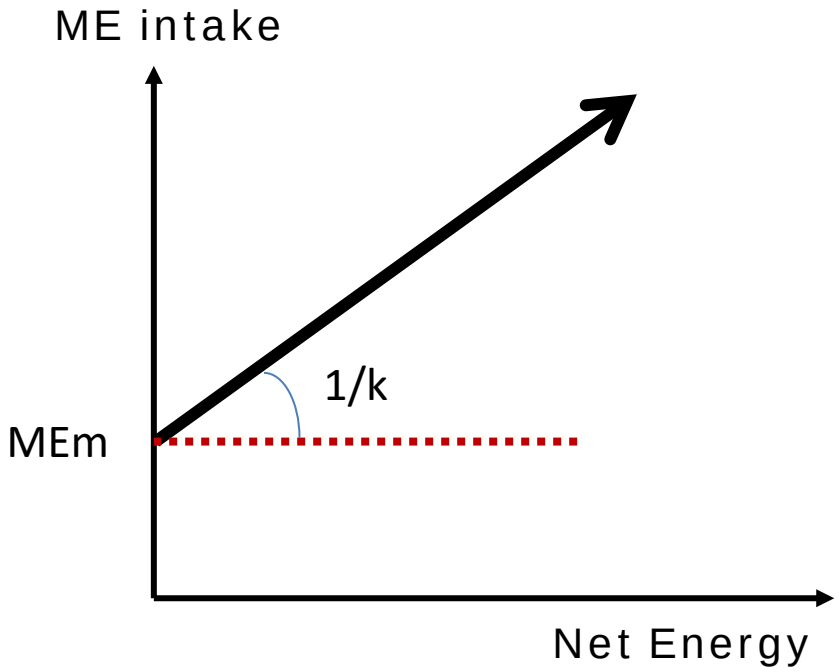
More precise quantification of protein losses (factorial approach)

Variability of PDIeff taken into account…

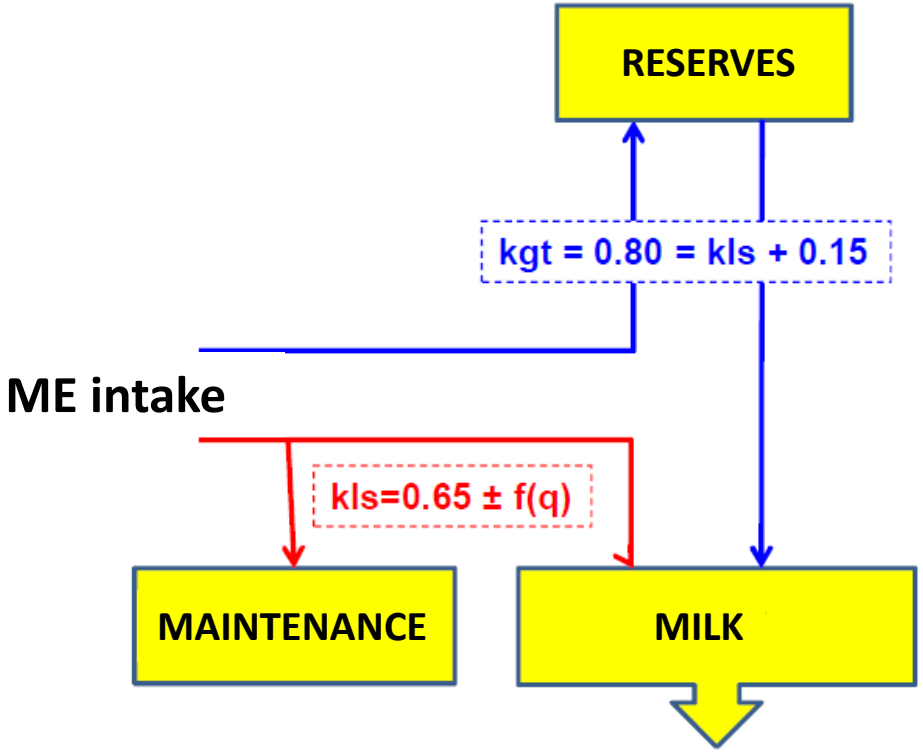
…Common to all functions of proteosynthesis

from Sauvant et al, 2016

Updating ME for maintenance and ME efficiency



ME for maintenance (MEm) updated for all species x production

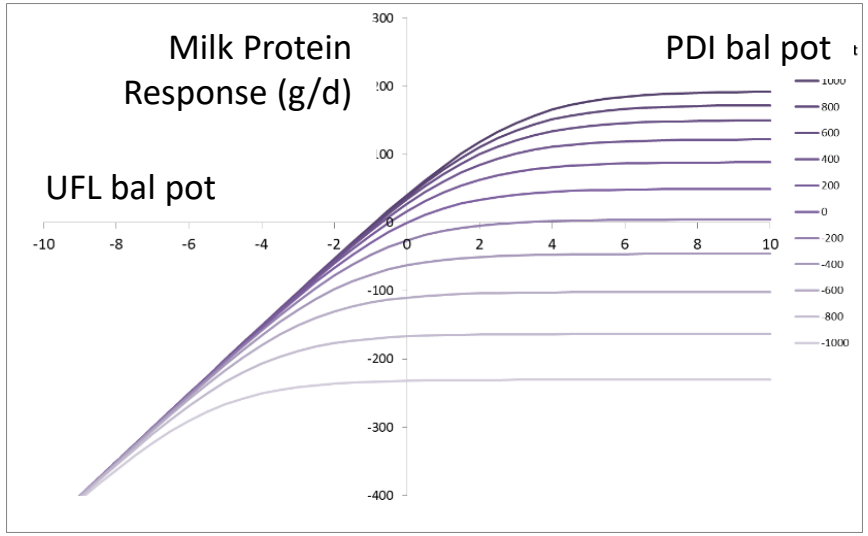


Dissociation of ME efficiency in dairy :
Kls : milk +maintenance
Kgt : reserves

From Sauvant et al., 2015

Productive responses

Based on knowledge of animal's potential (IC, yield, body reserves)



Responses predicted from :
- Animal's potential (yield, body reserves)
- UFL and PDI balances/potential and interactions

Integrated within **rationing** algorithms for dairy cows

Based on observed intake and performance

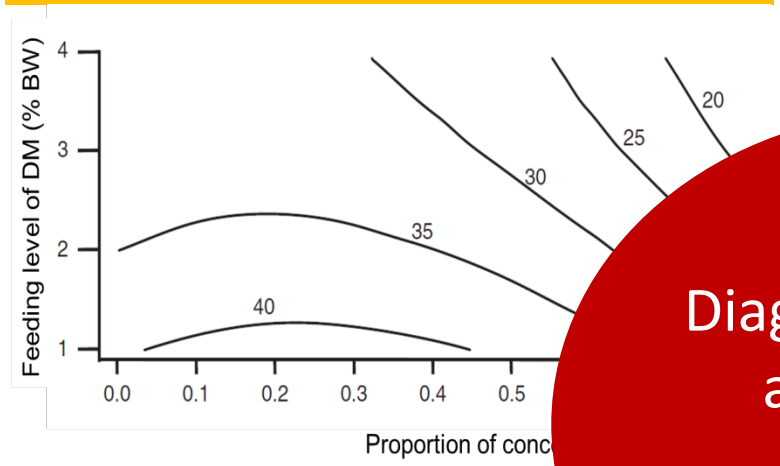
	ΔUFL_{EB0}	$\Delta UFL_{EB0}{}^2$	ΔPDI_{67}	$\Delta PDI_{67}{}^2$	RMSE
Δ Milk yield (kg/d)	0.575 (0.037)	-0.0163 (0.0054)	5.40 (0.35)	-3.31 (0.69)	0.88
Δ Fat yield (g/d)	4.503 (2.233)	-1.141 (0.4345)	159.18 (20.30)	-238.16 (39.16)	50.6
Δ Protein yield (g/d)	23.120 (1.356)	-1.141 (0.2716)	190.00 (12.60)	-192.57 (24.33)	31.4
Δ Lactose yield (g/d)	30.040 (2.491)	__	282.81 (24.90)	-172.43 (50.47)	51.5
Δ Fat content (g/kg)	-0.4835 (0.0523)	__	__	__	1.57
Δ Protein (g/kg)	0.1990 (0.0251)	__	0.60 (0.24)	-2.00 (0.45)	0.59
Δ Lactose (g/kg)	0.0715 (0.0155)	__	__	__	0.43

Responses predicted from :
- UFL and PDI supply / pivot situations (EB=0, PDIeff=67%)

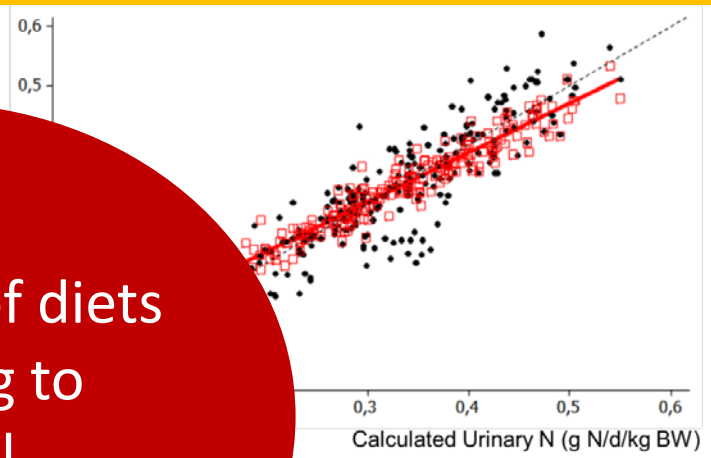
To anticipate average multiple responses to diet changes

Other responses

CH4 emissions

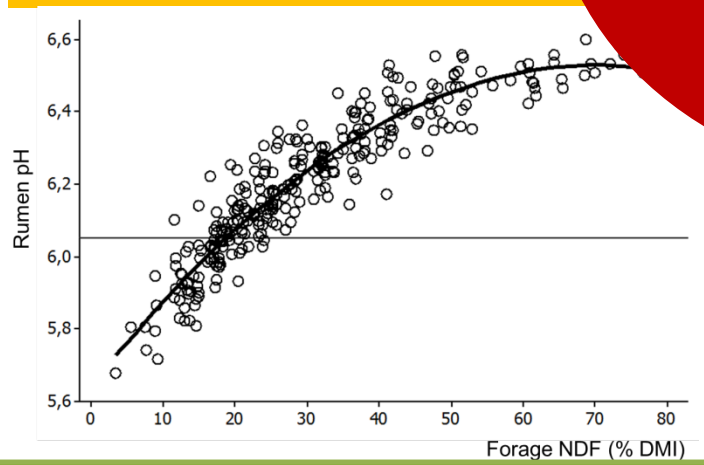


Urinary N

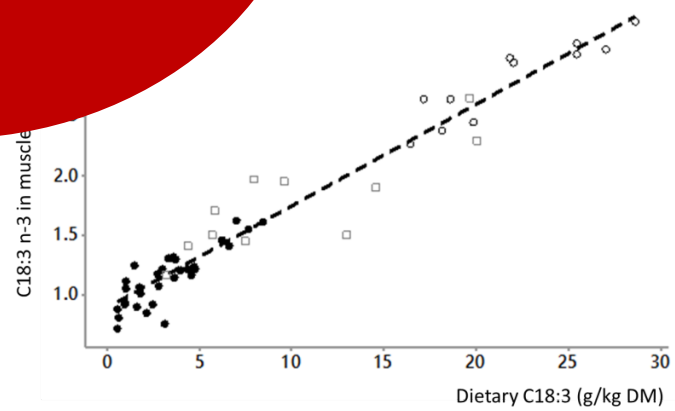


Diagnostic of diets according to several dimensions

Ruminal pH



tion of products



In conclusion…

INRA 2016 Feeding System for Ruminants

- Largely renewed
  - integration of large data bases
  - highly evaluated
  - expended functionalities
    - larger fields of application
    - Extended diversity of predicted responses
  - More evolutive

Available Soon !

- To better feed ruminants tomorrow
  - Efficiency of ressources utilisation
  - Anticipate multiple responses of animals to feeding practices

Other presentations related to the « Systali » project

- Session 40
  - Comparative prediction of **digestive interactions** in dairy cows (**Sauvant** et al, p 380)

- Session 62 (free communications animal nutrition)
  - Improving the prediction of **Amino Acid** Digestible in the Intestine through meta-analysis (**Lemosquet** et al, p 551)
  - Prediction of ruminal **starch degradability** of maize forage (poster 62-25 by **Peyrat** et al)
  - The INRA **feed tables and prediction equations** for forage quality evaluation (poster 62-27 by **Baumont** et al)

Thank you for your attention

SAVE THE DATE

September 2-6, 2018
Clermont-Ferrand, France

Website: https://symposium.inra.fr/isnh2018
Contact: isnh2018@clermont.inra.fr