Comparative prediction of digestive interactions in dairy cows

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PLAN

1.The systali project: Target and Methods
2. Empirical modelling of digestive interactions
3.The finnish and NRC proposals
4. Comparison of the 3 methods

1.1.Systali project: ultimate target

- Predictions of the flows of nutrients (MP, Am.Ac + VFA + Gaz + Glucose + Fatty acids …)

- Predictions of the animal responses to NE, PDI and other nutrients

- Enlarge the fields of applications (warm countries, intensive diets…)

➔ Necessity to progress on the issue of digestive interactions

1.2.Systali project: methods

➔ Large data bases (INRA & literature).

➔Meta-analyses ➔ empirical models ➔ new feed unit system

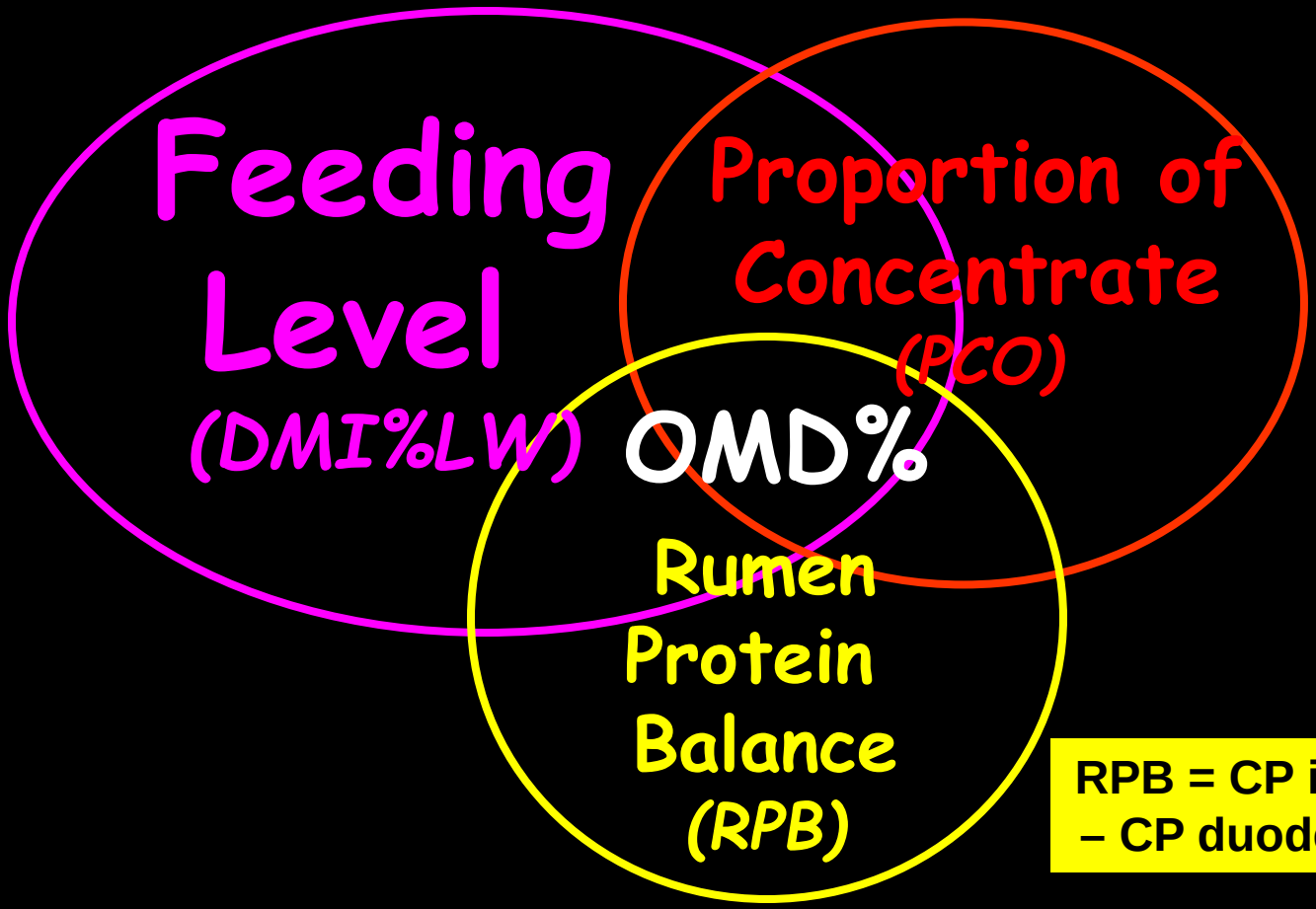
2. Empirical modelling of digestive interactions

$$VALUEdiet = \Sigma_i\ p_i\ TABLEVALUEfeed_i \pm I$$

Modelling I ?

- *Major impact : OMD%*
- *Predictors ? 3 major*

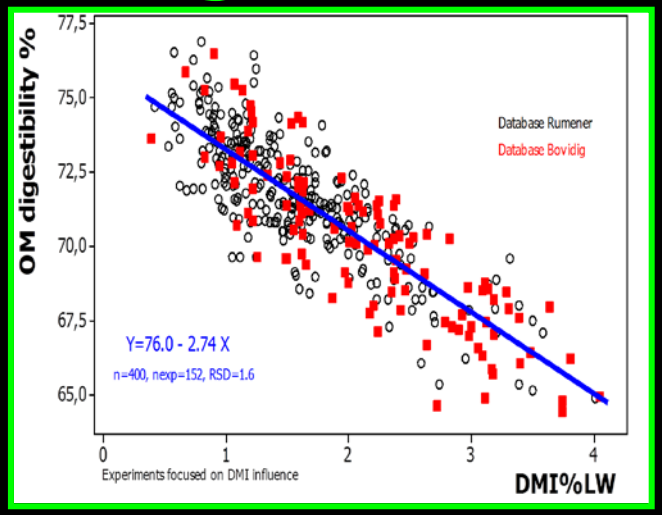
Major causes of digestive interactions altering OM Digestibility ?

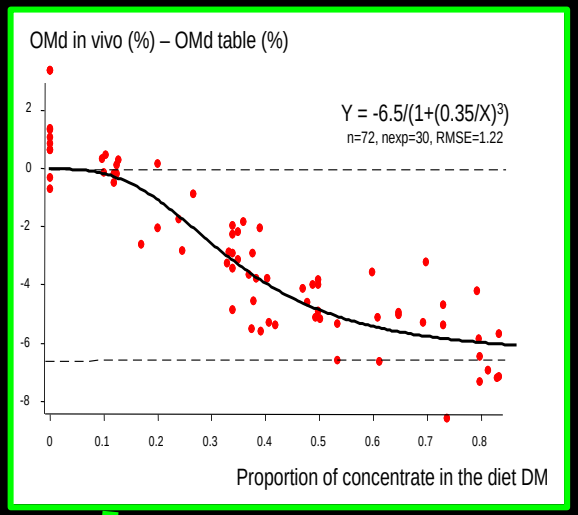


RPB = CP intake – CP duodenum

➔ 3 different data bases focused on these 3 factors

The digestive interactions (Sauvant & Nozière, 2016)

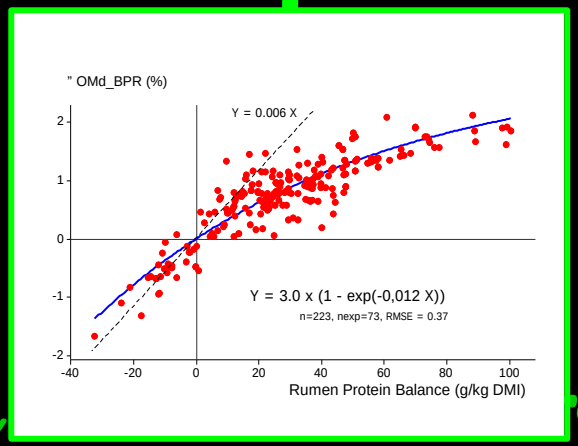




Feeding level
(Range 10 pts)

OMd in vivo – OMd « table »

Proportion of concentrate
(Range 6 pts)



Rumen Protein Balance
(Range 4 pts)

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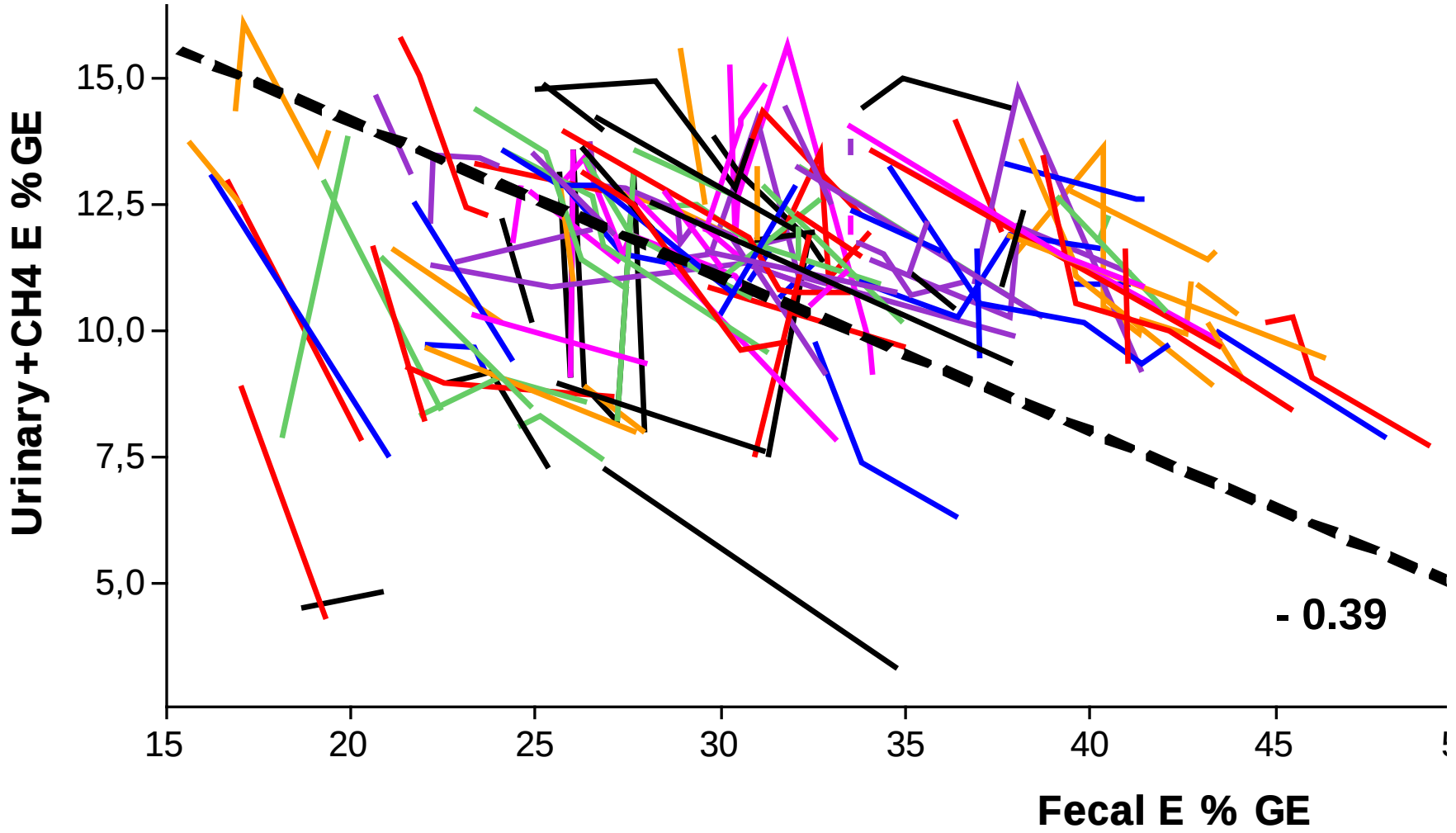
Other processes impacted by the 3 factors of DI

- CH4_E = f(FL, PCO)
- U_E= f(FL, CP, PCO)

➔ Impacts of DI on ECH4 and EU partly compensate that on OMD

➔ DI must be considered at least until the step of ME

Substitution between Fecal and CH4+Urine energy losses under influence of FL



Rumener database, 115 exp, 328 Trt

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3.1.Finnish model of digestive interactions

(based on meta-analyses of the literature, Huhtanen et al., 2009)

Corrected MEI (MJ/day) = Uncorrected MEI (MJ/d)
+ 56.7 - 6.99 × MEm
- 1.621 × DMI
+ 0.44595 × CP - 0.00112 × CP2

- DMI = Dry matter intake, kg/day
- MEm = Uncorrected ME concentration of the diet, MJ/kg DM
- CP = Crude protein concentration of the diet, g/kg DM

- Additivity of the 3 effects as in INRA

3.2.NRC model of digestive interaction

Use of multiplicative Discount Factor (0<DF<1, n=17))

$$DF = TDN1 - ((0.18\ TDN1 - 10.3) * \Delta I)/TDN1$$

with:

TDN1 = TDN at maintenance level

ΔI = Increment of intake above maintenance value of 1

→ DE at FL = (DE at FL=1)*DF

3.2.NRC model of digestive interaction

Formula from DE to ME:

$$ME\ kcal/kg = (1.01\ DE - 0.45) + 0.0046\ (EE-3)$$

$$\Delta ME = ME_{FL} - ME_1 = 1.01\ (DE_{FL} - DE_1)$$

➔ ***Variations of ME = variations of DE !***

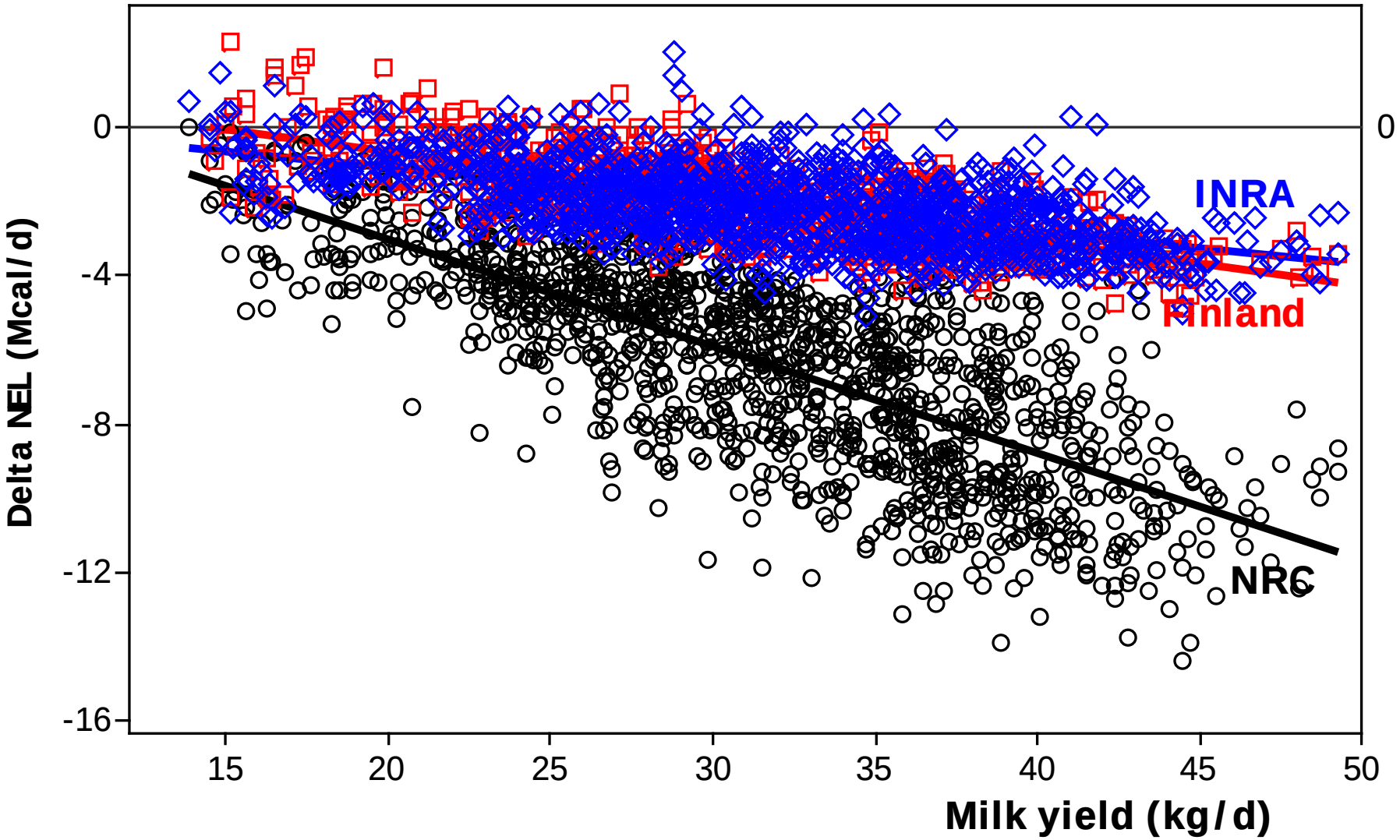
4. Comparison of the 3 methods

On the Bovidig-MoSARCO database

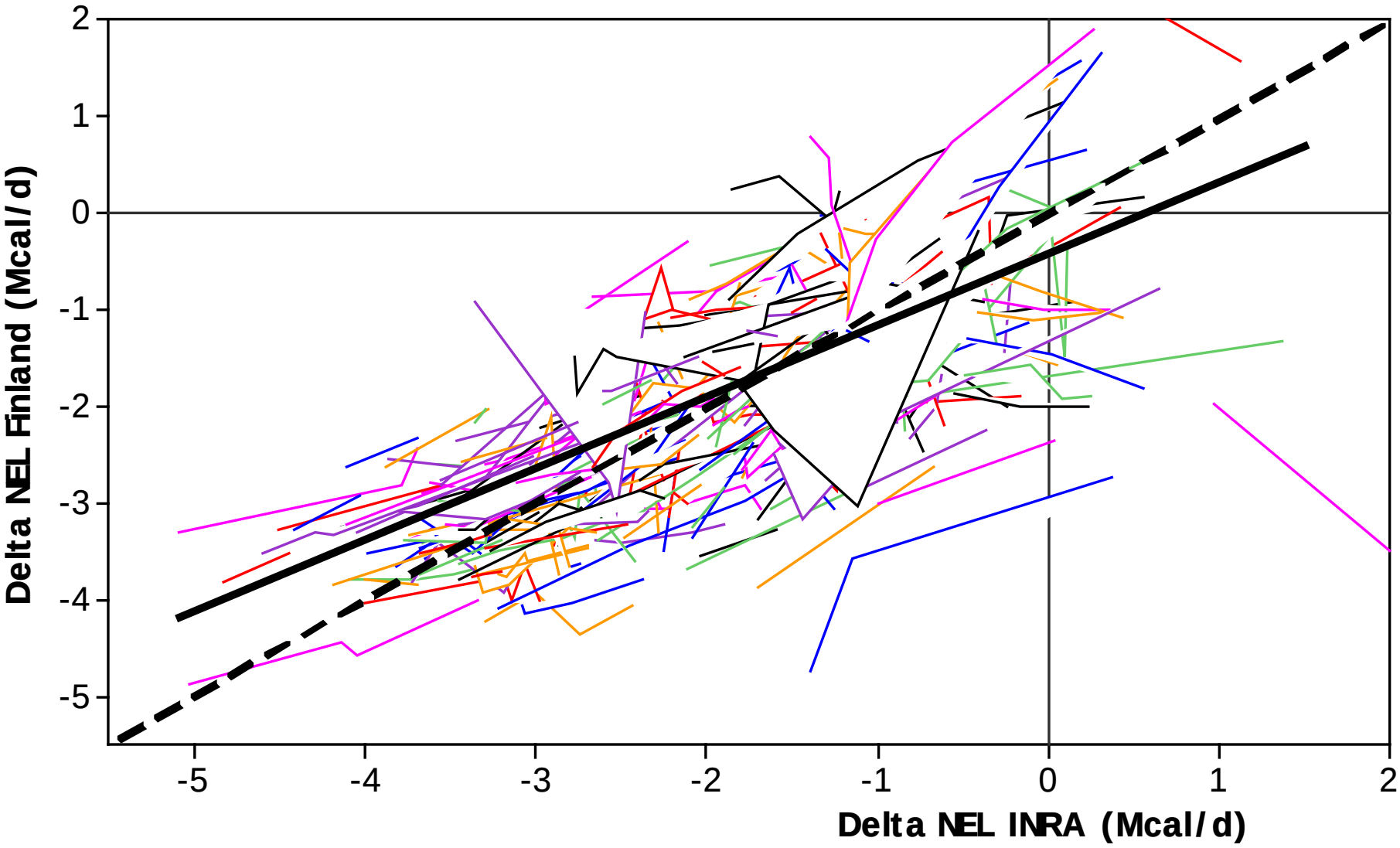
Subset of 278 experiments (815 treatments) focused on the influences of energy and protein supplies.

Criterium of comparison: ΔNEL intake in Mcal/d with the use of the same kls = NEL/ME value

Comparison of NEL corrections (Mcal/d) function of MY



Comparison of Delta NEL/d between Finland and INRA



Slope intra = 0.68<1; global slope = 0.74<1

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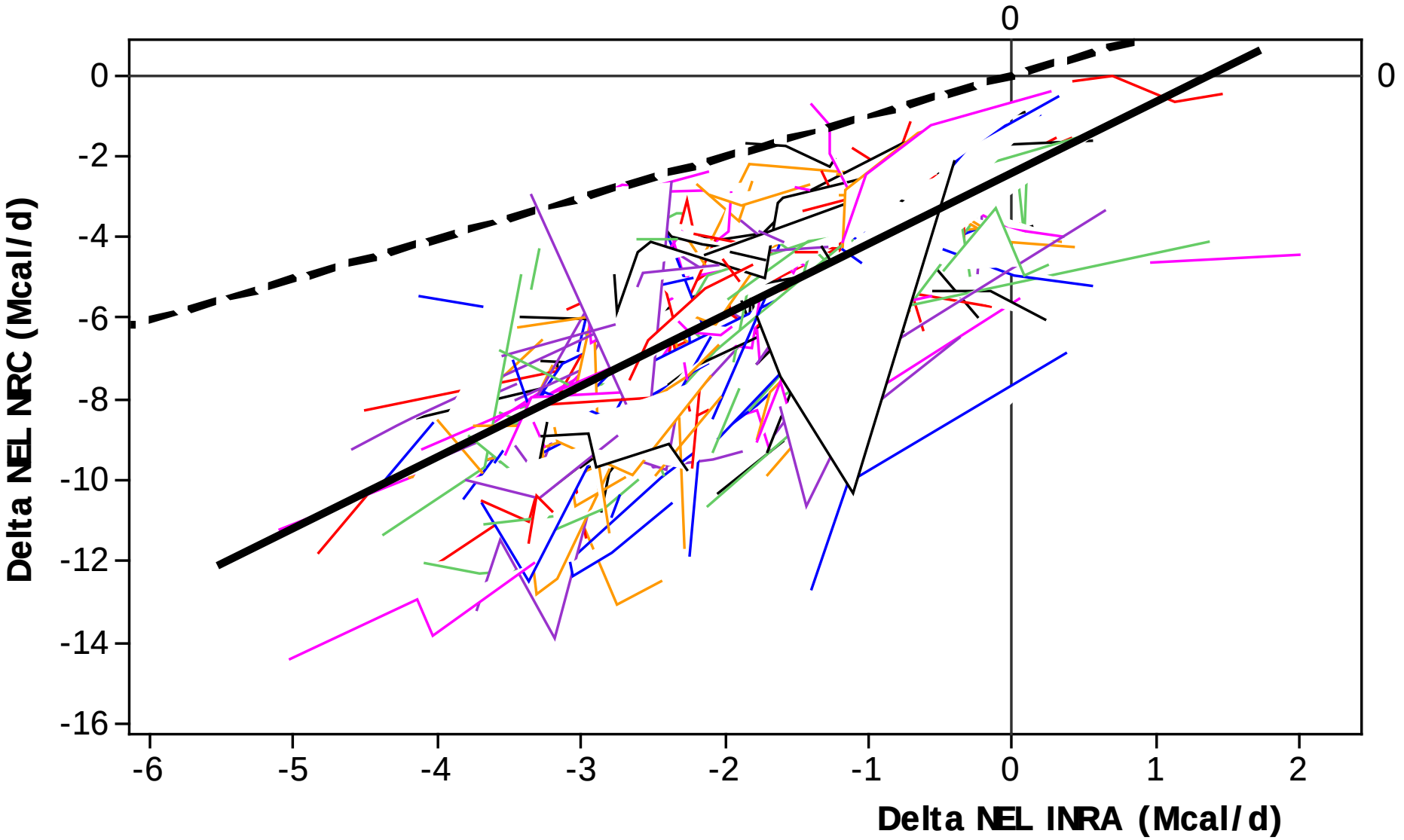
Comparison of Delta NEL/d between NRC and INRA



Intercept = -3 ` 0, slope=1.6>1

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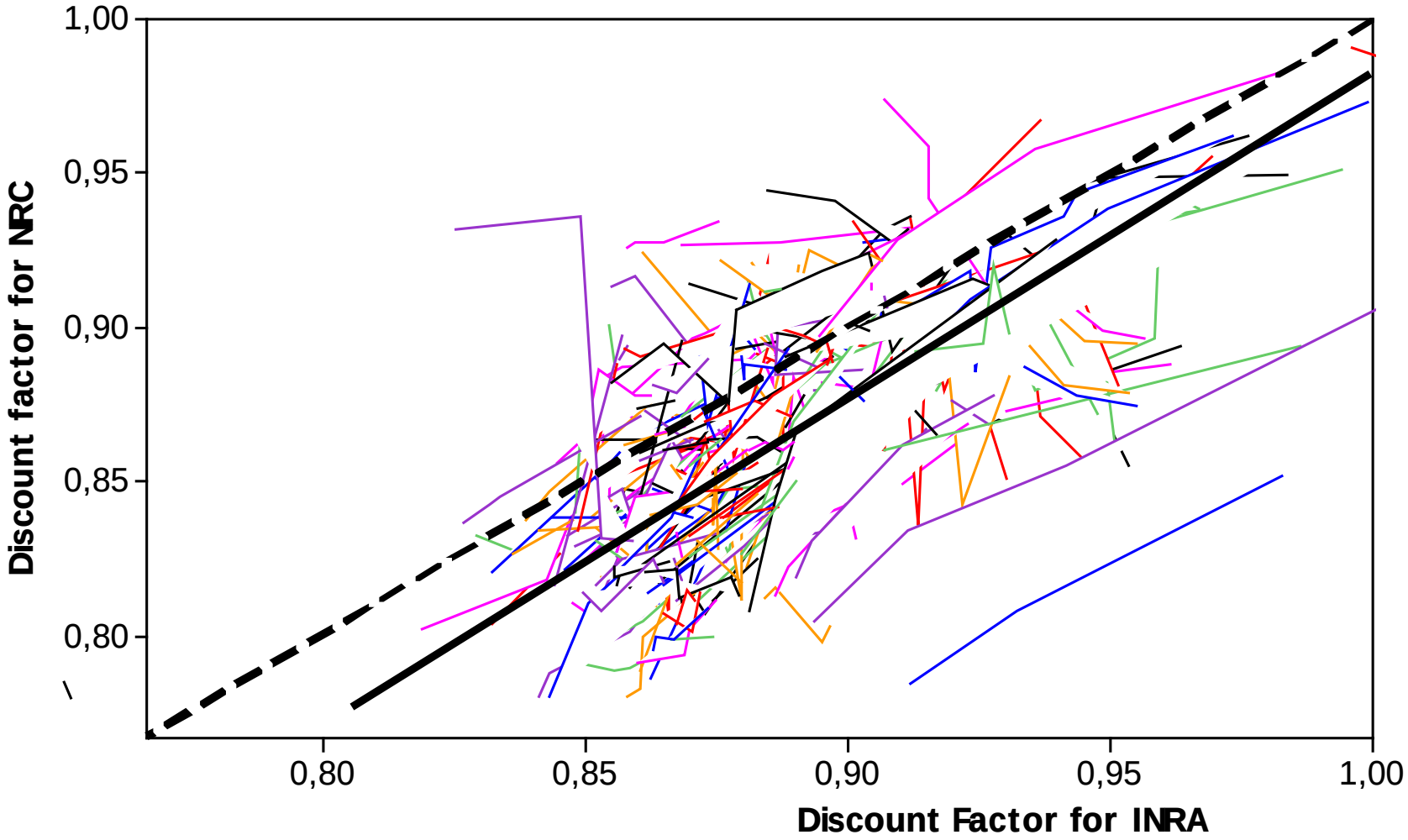
Comparison of Discount factors between NRC and INRA



➔ *Less difference on a dF basis*
➔ *Intercept = -0.12 ` 0, slope=0.84<1*
➔ *Mean difference of 0.02*

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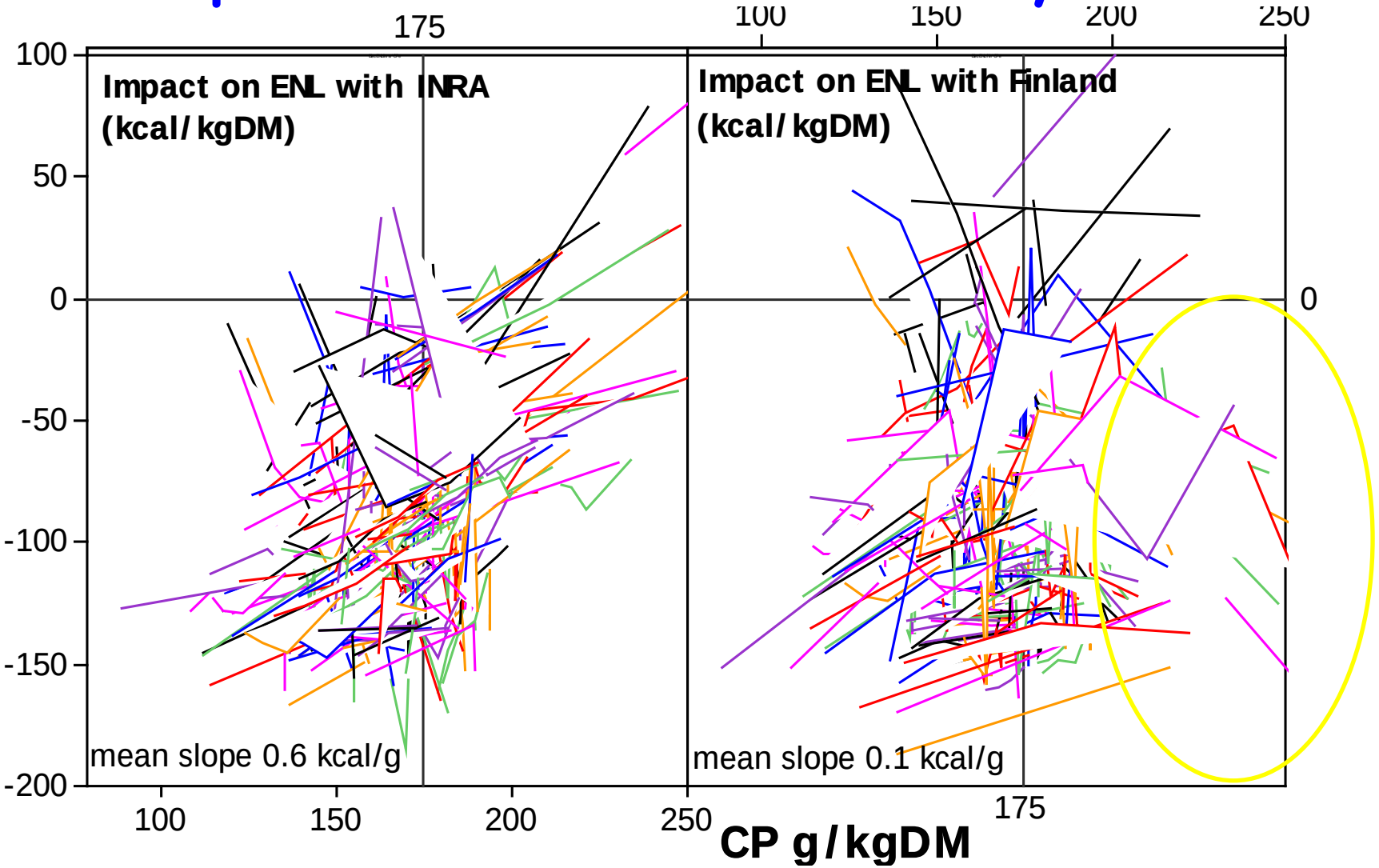
Intra experiment influence of dietary CP on DI



Exp focused on protein supply
Negative intra exp impact with NRC (slope -0.6)

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CONCLUSIONS

Empirical approaches have shown that digestive interactions can be quantitatively large and that they impact not only OMD but also CH4_E and Urinaty_E

The 3 major factors of DI present additive effects (cf INRA and Finnish systems)

Correction of NEL intake for DI are fairly similar between INRA and finnish systems

Correction of NEL intake for DI are higher for NRC than INRA and Finland, a difference exists at the digestive level, it is increased for ME and NE due to the fact that $\Delta ME \approx \Delta DE$

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