DETAILED DESCRIPTION OF THE *IN SITU* KINETICS AND SYNCHRONISM OF FEED FRACTIONS DEGRADATION

P. Chapoutot, D. Sauvant

UMR INRA-AgroParisTech MOdélisation Systémique Appliquée aux Ruminants (MoSAR)
Association Française de Zootechnie (AFZ)
16, rue Claude Bernard – F 75231 Paris Cedex 05 - mail: patrick.chapoutot@agroparistech.fr

Objectives

The valorisation of feeds by ruminants is largely dependent on their microbial degradation in the rumen and the partition between degradable and undegradable fractions. Nevertheless, the *in situ* degradation is rarely studied for all the components of dry matter (DM) and often dealt with only one or few of them.

The aims of this study were to achieve a detailed description of the kinetics of degradation of the main constituents of feeds and to explain the observed variations between feeds and constituents and to elucidate the synchronism of their availability for ruminal micro-organisms

Methods

- **10 feeds representative of the major types of kinetics of degradation (Chapoutot, 1998):**

  barley (BAR) maize (MAI) pea (PEA) dehydrated lucerne (DLU) dried brewer's grains (BRG) corn gluten meal (CGM)
  dehydrated sugar beet pulp (SBP) soyabean meal (SBM) formaldehyde-treated soyabean meal (TSBM) palmkernel meal (PKM)

- **Chemical composition of feeds: crude protein (CP) and soluble N (Nsol), Cellwall components (NDF, ADF and ADL)**
- ***In situ* degradation knetics of DM, CP, structural carbohydrates (SC=NDF) and non-protein cytoplasmic constituents (npCC=DM-CP-NDF) measured by Nylon bags methods (Michalet-Doreau *et al.*, 1987)**
- **Cumulative synchronism index (CSI) calculated over 9 consecutive time intervals from 0 to 72h:**

  [instantaneously (t=0), 0h-4h, 4h-8h, 8h-12h, 12h-16h, 16h-24h, 24h-36h, 36h-48h and 48h-72h]

  $$CSI = \sum_j (Ndeg_j - 0.032 \times npDMdeg_j) \quad (j \text{ varying from 1 to 9})$$

  - $Ndeg_j$ and $npDMdeg_j$: quantity of nitrogen and total carbohydrates (npDM=100-CP) available for micro-organisms along the different time intervals (j) with a relative rate of particles outflow from the rumen of $0.06h^{-1}$
  - optimal requirement for micro-organisms: 32g N/kg of degraded carbohydrates (Sinclair *et al.*, 1991 and 1993)

Results and Discussion

- **Large variety of degradation (deg) patterns between different feeds and components (figure 1)**

  CP and DM deg kinetics: fairly parallel, except for SBP and MAI (=very low CP deg during 10h or 20h), and BRG (=high proportion of undegradable CP Cellwall deg: quite long lag phase (almost 16h) for TSBM and PKM

Figure 1: Exemples of different degradation patterns

- **Variations of DM deg explained by different components according to the incubation times: Nsol at 1h (R=0.94), CC at 12h (R=83) and SC at 72h (R=86)**

- **Undegraded SC at 72h (g/kg DM) related to the ADL content of feeds (%DM):**

  $$QSC72h = 40.8\ ADL - 1.87\ ADL^2$$

  (n=10 ; R=0.98 ; RSD=20.9)

- **Large differences of synchronicity between N and carbohydrate availibility for microbes (figure 2):**
  - **fairly harmonious: DLU and PKM**
  - **deficit of nitrogen: BAR, SBP and MAI (-6, -10 and -12g N/kg feed)**
  - **excess of N: BRG, TSBM and PEA (+7, +12 and +15g N/kg) and above all CGM (+35g N/kg) and SBM (+45g N/kg)**

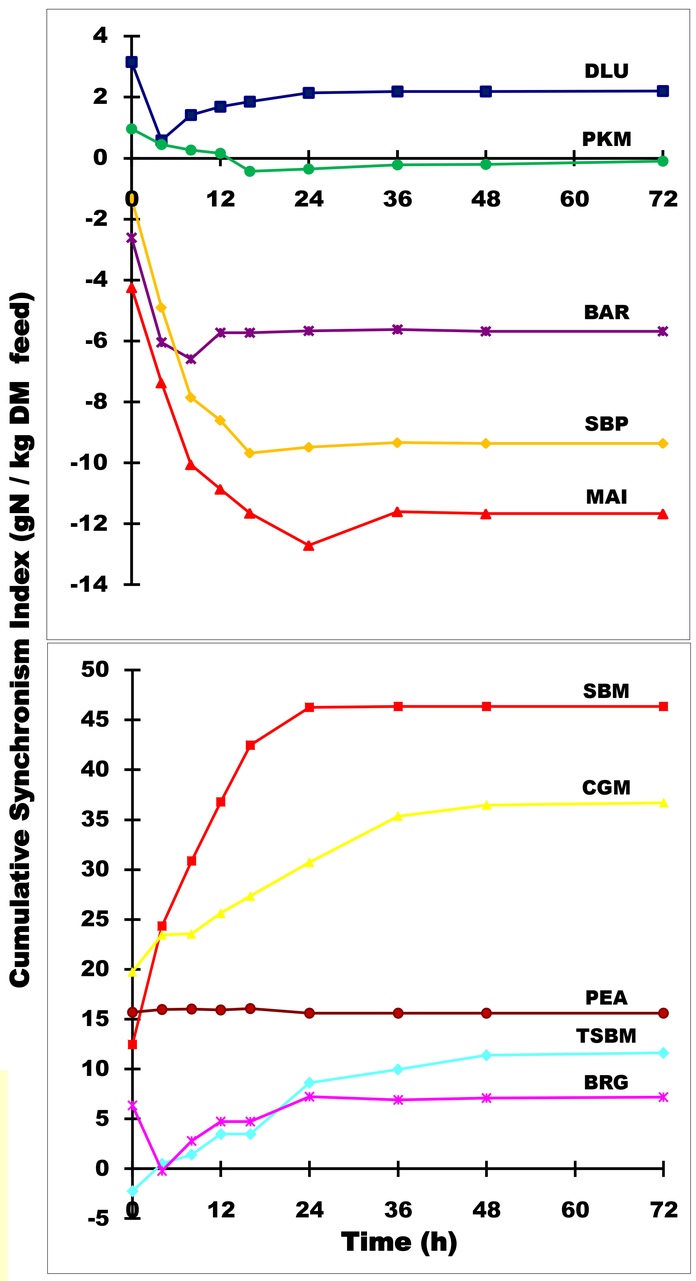

Figure 2: Evolution of the cumulative synchronism Index of feeds

Conclusion

This study confirmed the great variability of ruminal degradation patterns between feeds and components which was partially explained by chemical composition.
The feeds differed by their ability to provide, with synchronicity or not, nitrogen and carbohydrates for micro-organisms. This could largely influence microbial synthesis efficiency.