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Ruminal nitrogen degradability of HiPro sunflower meals and protein values for ruminants

BACKGROUND

Different kinds of sunflower meals (SFM) exist according to the level of seed dehulling before the crushing process: non dehulled (LoPro, LP), partially or highly dehulled (HiPro, HP). This leads to differences in crude protein (CP) and cell wall (NDF) contents, with a high range of variability [mean ± SD (min-max)]:

- *LoPro: CP = 30.7±1.8 (24-36) % DM, NDF=47.0±4.3 (26-59) % DM*
- *HiPro: CP = 40.5±1.5 (36-55) % DM, NDF=34.9±5.5 (22-49) % DM*

(INRA-CIRAD-AFZ Tables, 2018; www.feedtables.com)

Currently, about 900,000 tons of HiPro sunflower meal are imported in France, especially from the Black Sea area *(Terres Univia, 2017)*.

OBJECTIVE

The aims of this study were:

(i) to measure the rumen nitrogen degradability of imported HiPro SFM,

(ii) to verify the relationship between nitrogen *in vitro* enzymatic and in sacco degradability for these feeds,

(iii) to estimate their protein values for ruminants in the new INRA system (2018)

Image credit: Gilles Tran (AFZ)

MATERIAL AND METHODS

➢ 65 samples of SFM, collected to study the variability of their chemical composition (*15 French & 50 imported from 8 countries*)
(CP=390±42 g/kg DM; NDF=324±70 g/kg DM; N in vitro enzymatic degradability, *NED1=54.7±4.8 %)*

➢ 15 samples chosen among them, representative of the observed range of CP, NED1, origins and types (Table 1).

Table 1: Chemical composition of the 15 tested SFM [1]

	Mean	SD	Min	Max
DM (%MB)	**89.8**	**1.4**	87.5	92.5
Ash (g/kgMS)	**77**	**7**	63	89
CP (g/kgMS)	**390**	**47**	298	506
Fat (g/kgMS)	**19**	**7**	13	41
CF (g/kgMS)	**207**	**49**	96	314
NDF (g/kgMS)	**319**	**83**	95	461
ADF (g/kgMS)	**210**	**84**	14	344
ADL (g/kgMS)	**64**	**21**	15	104
NSol_KOH (%)	**76.9**	**3.6**	71.3	82.8
NED1 (%)	**53.1**	**6.3**	40.5	63.7

[1] France: 6; Ukraine: 5; Argentina: 2; Hungary: 1; Bulgaria: 1
HiPro: 12; LoPro: 2; Sieved (after crushing process): 1

Measurements and calculations

- *On the 15 samples of SFM: In vitro method (NED1) according to Aufrère et al., (1989), In sacco method described by Michalet-Doreau et al., (1987); double Latin square including 3 cows and 6 replicates.*
- *Dry matter and Nitrogen degradation (degDM, degN) kinetics adjusted with a non-linear model (Ørskov & McDonald, 1979):* $Deg(t) = a + b(1 - e^{-c\,t})$,
  with a & b: soluble & degradable fractions, c: degradation rate of b fraction.
- *Nitrogen effective degradability calculated according to INRA 2007 with a rumen turnover rate of particles (kp=6%h⁻¹):* $ED6N = a + b \times c/(c+kp)$
  and according to INRA 2018 with a turnover rate of liquid (kl=9.71%h⁻¹) and of particles (kp=4.97%h⁻¹): $EDN = a \times 100/(100+kl) + b \times c/(c+kp)$
- *Statistical variance-covariance analysis (GLM Procedure - Minitab) on degDM & degN with « feed » (i), « cow » (j) and « day » (k) effects, associated with a covariable degDM of a standard feed (degMS_std$_{jk}$):* $Deg(t)_{ijk} = \mu + \alpha_i + \beta_j + \gamma_k + \delta\, degDMS\_stand_{jk} + \varepsilon_{ijk}$
- *Data integrated in the new INRA 2018 system to estimate the nitrogen values of these SFM.*

RESULTS AND DISCUSSION

✓ EDN varied from 80 to 87 % with a mean value (83.4±1.9) higher than INRA 2018 tables (+7points)

✓ Very closed EDN mean values for the different types of SFM and various origins

✓ Relationships between ED6N and NED1 on 15 SFM samples (figure 1)

ED6N = 70.8 + 0.29 NED1(%) (n=15 ; R^2=48.4 ; ETR=1.9)

No statistically different slope from SFM samples in Aufrère model

→ Same model with a common slope & delta=+10 points between the 2 data sets:

SFM Experience (n=15) : DT6_N = 67.1 + 0.36 DE1(%)
SFM (Aufrère et al., 1989) (n=5) : DT6_N = 56.9 + 0.36 DE1(%)
(Ntot=112; Ngroups=13; R^2=0.97; ETR=2.9)

✓ Compared to INRA 2018, quite different "Table" protein values of the 12 studied HiPro SFM, but similar "Tables" net energy values:

PDI = 109 ± 6 g/kg DM & RPB = 235 ± 18 g/kg DM
UFL = 0.88 ± 0.02 /kg DM & UFV = 0.81 ± 0.03 /kg DM

(INRA 2018: CP=405 g/kg DM & NDF=349 g/kg DM;
PDI=137 g/kg DM & RPB=216 g/kg DM; UFL=0.86 /kg DM & UFV=0.79 /kg DM)

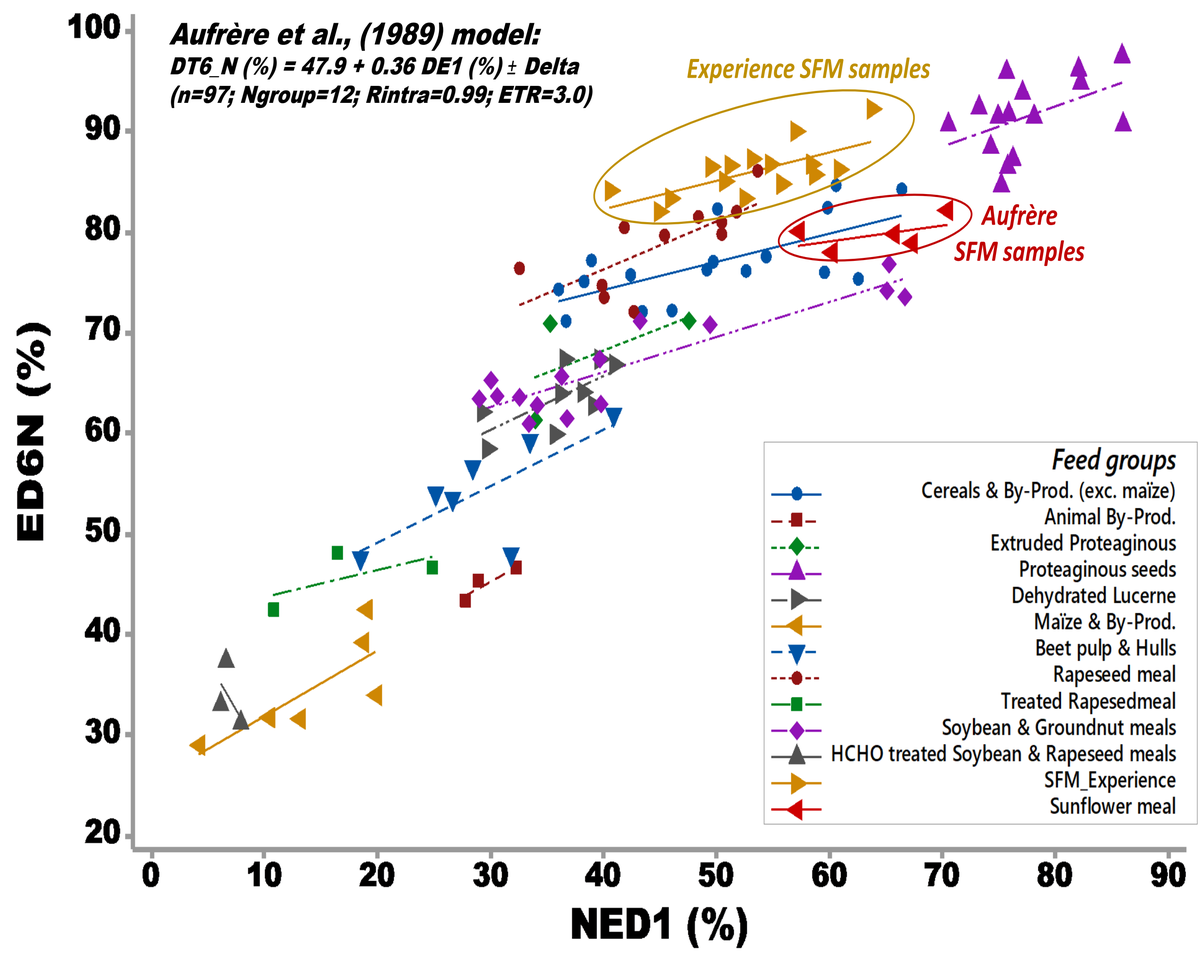

Figure 1: Relationship between ED6N (in sacco) and NED1 (in vitro) values for tested SFM compared to samples of Aufrère et al., (1989)

CONCLUSION

❖ Large and recent data set of sunflower meals from various origins
❖ Similar N degradation kinetics for French & imported HiPro SF meals
❖ Higher observed EDN values compared to INRA 2018 Tables
❖ Same slope between ED6N and NED1 than that of Aufrère *et al.*, (1989) but higher intercept for the 15 studied SFM samples
❖ Protein values different from INRA 2018 Tables

References

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