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*Published in:*  
Modelling Nutrient Digestion and Utilization in Farm Animals

*Publication date:*  
2009

*Document version*  
Publisher's PDF, also known as Version of record

*Citation for published version (APA):*  
Nørgaard, P., Nadeau, E., & Randby, Å. (2009). A new nordic structure evaluation system for diets fed to dairy cows. In *Modelling Nutrient Digestion and Utilization in Farm Animals* Editions Quae.

7e International Workshop

# Modelling Nutrient Digestion and Utilization in Farm Animals

Paris September 10th-12nd, 2009



## A NEW NORDIC STRUCTURE EVALUATION SYSTEM FOR DIETS FED TO DAIRY COWS

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The overall aim was to establish a model for a quantitative ranking of the fibrousnesses of individual feeds and rations for high yielding dairy cows within the NorFor-plan based on the principles in the Danish chewing index system, but by use of neutral detergent fibre (NDF) instead of crude fibre (CF). The specific objective was to establish a model for prediction of eating- (EI) and ruminating index (RI) values and total chewing index (CI) values where  $CI = EI + RI$  (minutes/kg DM intake) for feeds depending on the content of physically effective structural fibre (PeNDF). The EI values were assumed to be proportional with the NDF content and a particle size factor (FS\_E). The RI values were assumed to be proportional with the NDF content, a particle size factor (FS\_R) and a hardness factor (H). The FS\_E and FS\_R were predicted from exponential functions of the theoretical chopping length (TCL) and their values ranged from zero in finely ground feed to one in unchopped forages. The TCL length values were assumed to reflect the most frequent particle length in chopped or processed feeds. The EI and RI models were parameterized in terms of min per kg forage PeNDF (fNDF) by a Meta analyse of 80 published treatments for daily time spent eating and ruminating by cattle fed unchopped forages with or without concentrate (C) supplementation with body size and recording method as fixed effects, experiment as random effect and with number of animal per treatment as weight. The RI model included in addition forage type, H, intake of fNDF per BW and the NDF in C to fNDF ratio as fixed effects, and resulted in a RMSE value of 20 min per kg fNDF. The H value for alfalfa hay was set to 1.1 and estimated as  $(2.6-19/CF\%)$  relative to  $(2.6-19/26)$  based on Deboever et al. 1993 for other forages. The CF values were transformed to NDF and reverse in case of no reported values based on the relationship between 25 reported NDF and CF values within the dataset. The EI model included in addition physiological state, daily ruminating time,  $\log(\text{silage DM percentage})$  nested with forage type and C to fNDF ratio as fixed effects, and resulted in a RMSE value of 27 min per kg fNDF. The FS\_E and FS\_R were parameterized based on information on particle characteristics of the physically processed forages, such as TCL and mean particle size in a Meta analyse of 25 published treatments. The H factor value is considered to be estimated as  $H=0.75 + \text{INDF}/\text{NDF}$ , which ranked immature spring grass to 0.75 and highly lignified forage legume fibres to 1.2. The models can be used for prediction of CI values of differently processed forages, concentrates and by-products. The models predict the FS\_E and FS\_R values of grass silage with a TCL value of 10 mm to 0.73 and 0.93, respectively. The EI, RI and CI values of medium quality long grass silage with 26 % CF were smoothed to 50, 100 and 150 minutes per kg NDF, respectively. A minimum dietary CI value of 32 minutes per kg DM intake is recommended to ensure optimal rumen function and prevention of digestive disorders.