

STSM Purpose: **Development of a rumen model to measure by-pass protein and improve dairy care**

Topic: "Development of a rumen model to measure by-pass protein and other characteristics, as well as identification of the respective biomarkers"

Scope

Welfare of animal includes adequate availability of nutrients. Feeding of high producing dairy cows, especially during transition period is not always adequate. High demand in energy and protein requirements cannot be met so animals enter negative energy balance. New feed additives and feed sources are being tested to increase amount of energy and protein available to the dairy cows. One of these are bypass protein and bypass fat. *In vitro* methods are being used to test the efficiency of this products, yet there is still no adequate *in vitro* model to do this. Aim of this STSM will be to develop an *in vitro* ruminant gastro-intestinal model which simulates the ruminal and intestinal digestion.

Existing *in vitro* technique used to determine intestinally absorbable dietary protein of individual feed uses the three-step *in vitro* procedure which provides an alternative to the use of intestinally cannulated animals for estimating intestinal digestion of protein supplements. Because of variation, differences in digestion of proteins among and within various feed sources adaptation of technique should be considered when determining bypass protein value for ruminants. Depending on the type of substrate to be tested, adaptations of the existing model (Calsamiglia and Stern, 1995) will be necessary, as in this case, the goal will be to assess the bio availability of rumen by pass products, based on fat coated/encapsulated products. Differences in the pH of the digestive tract between ruminants and non-ruminants, and biology of digestion and absorption of fatty acids between the ruminants and non-ruminants show the need to improve existing method, especially for the purpose of fat coated bypass protein digestibility research.

Goal

In vitro assessment of bio-availability of rumen by-pass products based on fat coated/encapsulated products

Proposed *in vitro* model as starting point

An adaptation of the models of Calsamiglia/Cargallo (*in vitro* protein digestion) and the RUSITEC model developed for the analysis of rumen protected products.

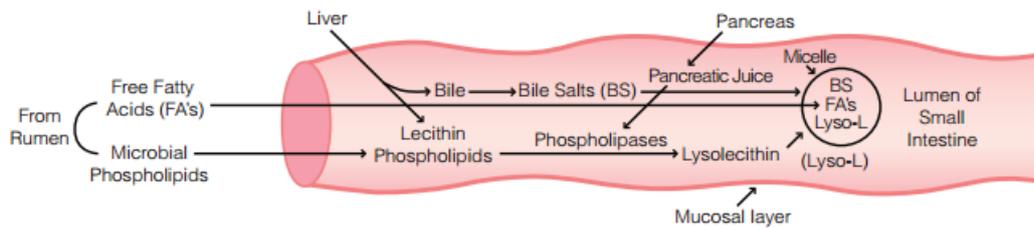
in vitro model: 3 steps:

- 1. rumen simulation**
- 2. gastric phase**
- 3. Intestinal phase**

Points of attention:

- Ruminal retention of individual particles and flow dynamics:
 - o Specific incubations have to be investigated
- Rumen retention time = left shifted Gauss curve: possible retention time: from minutes to 24hrs

- Goal= using realistic incubation times
- Lipid metabolism:
 - Hydrogenated fatty acids = highly rumen by-pass
 - *Ruminal fluid* is strictly not necessary in this model, but can be of added value in case of no pure hydrogenated fatty acids are used in the process of 'by-pass' production.
 - in the duodenum: micel-formation = key factor
 - in ruminants: reproduced from Davis - 1990



- Specific characteristics for ruminant should be integrated in the model (Lock et al., 2006).

Time frame

This work includes time frame 15. 1. 2015 .- 28.2. 2015. and will exchange a Croatian ESR to Belgian R&D company, both MC members within COST Action DairyCare.

During this STSM

Research technics will be exchanged as Host institution Nutrition Sciences N.V., Belgium is one of the leading companies in animal feed science and has well established R&D sector. Early stage researcher coming from Croatia and visiting Host institution will learn new research technics and build up knowledge for future research. Future collaboration with host institution will be achieved by means of publication of the scientific articles and by means of further collaborative research and writing in the future.

Lock, A. L., K. J. Harvatine, I. Ipharraguerre, M. van Amburgh, J.K. Drackley and D.E. Bauman (2006): Dynamics of ruminant fat digestion. *Feedstuffs*. 78: 7, 1-2

Calsamiglia, S. and M. D. Stern (1995): A three-step in vitro procedure for estimating intestinal digestion of protein in ruminants. *J ANIM SCI* 73: 1459-1465.