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Conceptual model of digestion for pigs and poultry and its factors of variation

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Context

Sustainable Livestock

- Feed cost
- Environmental impact

Diversification of feedstuffs

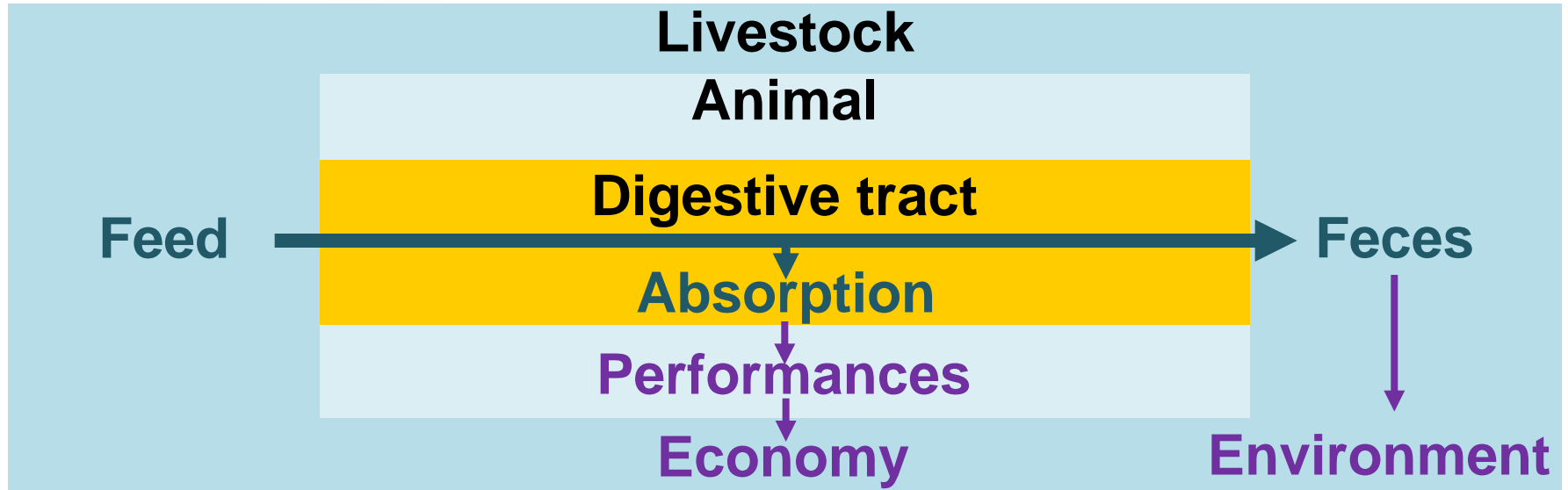
- Local
- By-products

Formulation

- Animal requirements
- Nutritional values

Present calculation of feed nutritional value

- ❖ Additivity : ~~Interactions~~
- ❖ Factors of variation



Aim : Improving prediction of nutritional value

Hypotheses

Intake	Stomach	SI	LI
Kinetic of DM	Enz.	Enz.	Micro.
Feed consumption	HCl pH	pH	pH
Water consumption	MRT	MRT	MRT
	Hydro.	Hydro.	Ferm.
		Abs.	Abs.

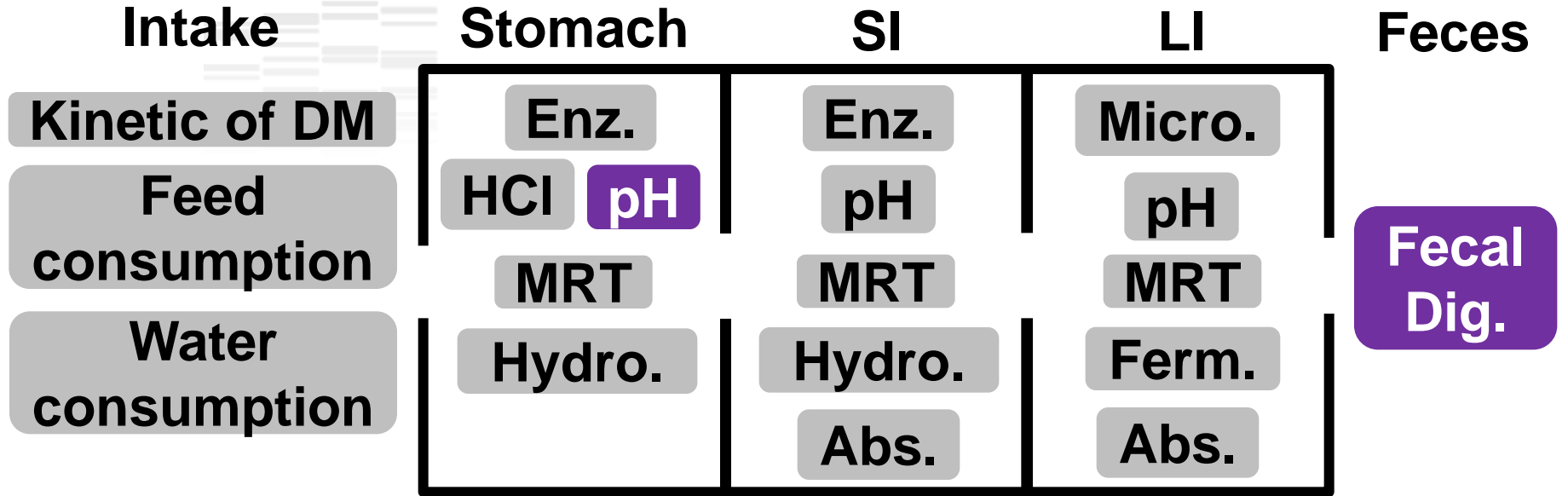
Abdollahi, M. R et al. 2015; Adedokun, S. A. et al. 2007, 2014, 2015; Adeola, O. and A. J. Cowieson 2011; Amerah, A. M. et al. 2008, 2009; Angel, R. et al. 2010; Ao, T. et al. 2008; Bach Knudsen, K. E. 2001; Barekatin, M. R. et al. 2013; Bedford, M. R. 1995; Boumans, I. J. M. M. et al. 2015; Carré, B. 2000; Choct, M., et al. 1992; Diebold, G. et al. 2004; Dourmad, J. Y. 1988; Frikha, M. et al. 2009; Fru-Nji, F. et al. 2011; González-Alvarado, J. M. et al. 2007, 2008; Hassan, A. S. and P. Delpech 1986; Hetland, H. et al. 2002; Jiménez-Moreno, E. et al. 2009, 2013; Le Gall, M. 2009; Le Goff, G. et al. 2001, 2002a, b; Létourneau-Montminy, M. P. 2010, 2012; Li, W. et al. 2015; Liu, S. Y. et al. 2013; Low, A. G. et al. 1985; Mateos, G. G. et al. 2007; Mavromichalis, I. et al. 2000; Métayer, J. P. et al 2015; Miquel, N. et al. 2001; Morel, P. C. H. et al. 2006; Nyachoti, C. M. et al. 2004; O'Grady, J. F. et al. 1985; Owusu-Asiedu, A. et al. 2006; Péron, A. et al. 2005; Ravindran, V. and W. H. Hendriks, 2004; Rynsburger, J. M. 2009; Sklan, D. 2001; Svihus, B. 2014; van Leeuwen, P. et al. 2006; Weurding, R. E. et al. 2001; Wilfart, A. 2007; Wilfart, A. et al. 2007a; 2007b; Xu, Y. et al. 2015; Yegani, M. and D. R. Korver 2013; Zaefarian, F. et al. 2015

Hypotheses

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Fibres: (Wilfart et al., 2007a and b)

Hypotheses



Age : (Jimenez Moreno et al., 2009)

Modelling: simplified representation, integration of knowledges → Understand and predict feed use mechanisms

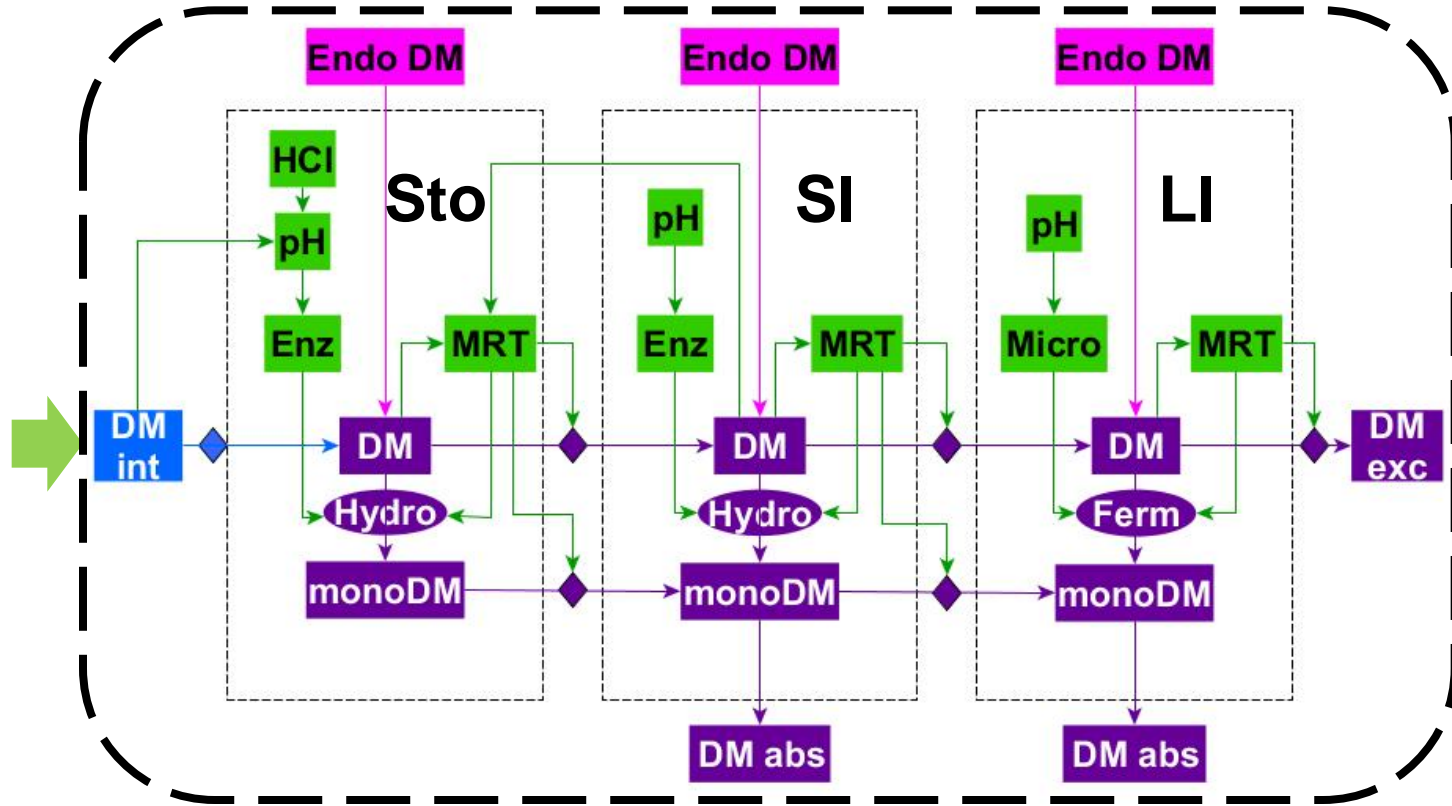
Modelling

Present models of feed use mechanisms in monogastrics	New model of feed use mechanisms in monogastrics
Additive	Interactions
Single-specie	Generic
Single-nutrient	Main nutrients
Single-compartment	Mechanistic (anatomical compartments)
Dynamic (timestep day)	Dynamic (timestep hour)

(Usry et al., 1991; Bastianelli et al., 1996; Rivest et al., 2000; Strathe et al., 2008; Tharakan, 2009; Symeou et al., 2012; Taghipoor et al., 2014; Létourneau-Montminy et al., 2015)

Conceptual model: Digestion of Dry Matter

Variation
Factors



equations
Differential

Conceptual model: Transit of dry matter

Input Output Input Output Input Output

Sto Sto SI SI LI LI

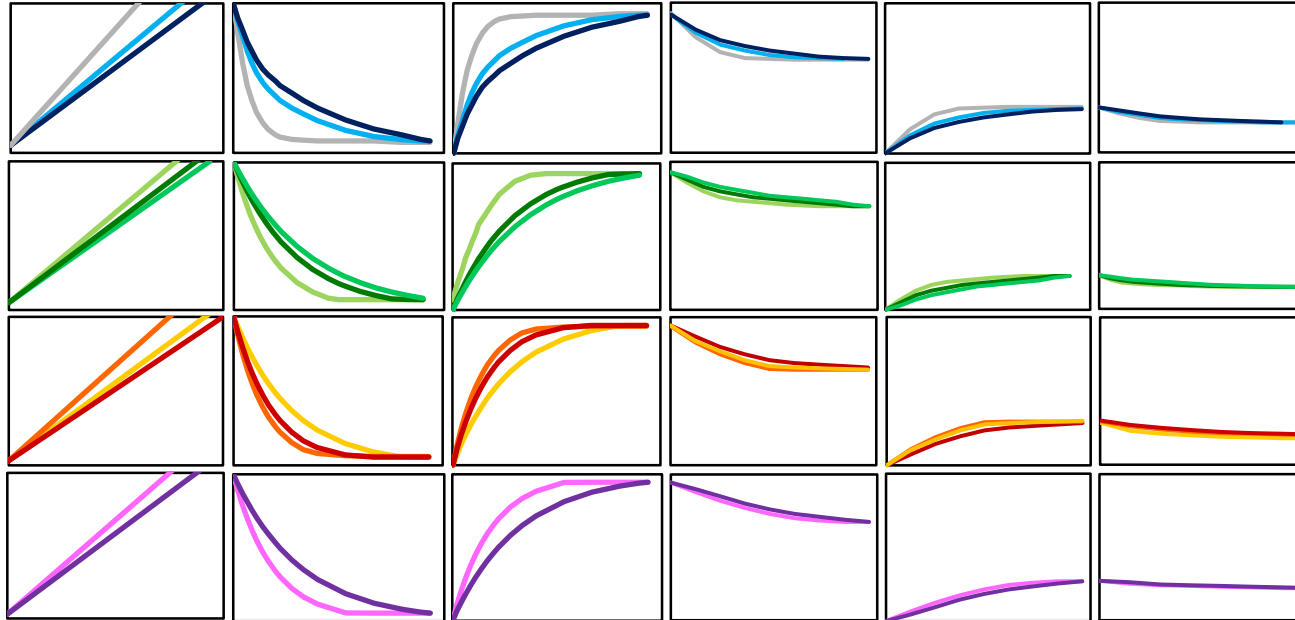
- Weaned
- Growing
- Finishing
- Dry
- Gestating
- Lactating
- Starter
- Growing
- Finishing
- Pullet
- Laying

Pig

Sow

Broiler

Layer



Auffray et al., 1967; Keys and DeBarthe, 1974; Laplace, 1975; Laplace and Germain, 1978; Cuber and Laplace, 1979; Laplace et al., 1983; O'Grady et al., 1985; Dourmad, 1988; Vergara, 1989; Gregory et al., 1990; Potkins et al., 1991; Usry et al., 1991; Bastianelli, 1996; Mahan, 1998; Hess and Seve, 1999; Miquel et al., 2001; Yen, 2001; Jorgensen et al., 2010; Rougière and Carré, 2010; Svihus, 2011; Svihus, 2014; Xu et al., 2015

Achievements and Prospects

Generic representation of DM inputs and outputs

Improvement of the conceptual model

- ❖ Stomach input depending on DM intake model
- ❖ Main factors of variation (intrinsic to feed) and interactions
- ❖ Build equations ' Calibration
- ❖ Software development

A model to improve prediction of nutritional value and optimize diet formulation

→ **Better control of nutrient inputs and outputs**



Thank you for your attention