



"SYSTOOL", A NEW CALCULATION TOOL FOR THE FRENCH "SYSTALI" PROJECT

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Objectives

The new French feed unit system, developed by INRA in the Systali project, is based on digestive flows of nutrients and multiple animal responses (Sauvant et al., EAAP 2013). It integrates a mechanistic digestion model accounting for the effects of feeding level (FL), proportion of concentrate (PCO) and rumen protein balance (RPB), on digestive processes. A new calculation tool has been developed in order to determine the new nutritive values and nutrient flows easily and to validate them by comparing them to the animal responses described in published experimentations.

Systool design

Systool is implemented with Excel and linked to the new INRA feed table proposing feed values calculated with a reference value for FL, with the hypothesis of PCO=0 and ignoring RPB. Systool calculates the feed and ration values by taking into account the digestive interactions (DI) due to FL, PCO and RPB (Figure 1) and compares them to the observed values in the publications.

Systool operation mode

- The trial is described: characteristics of animals (species, body weight), feedstuffs (20 feeds max) and rations (feed and diet composition, *in vivo* measurements...) for different treatments (16 max).
- Feeds whose composition best matches the reported data are selected in the INRA table by the user, who specifies their level of incorporation in the diets (X_i).
- The Systali 'Table' values of each feed (FTV_{*i*}) are automatically extracted from the INRA table (yellow values in Figure 2).
- Systool calculates the nutrient flows and the values of feeds "in the ration" (FRV_{*i*}) according to the FL and PCO of the actual diet. The RPB of the ration, calculated as an output variable, can also modify these FRV_{*i*} thanks to an iterative calculating process, which rapidly converges toward a final prediction (orange values in Figure 2).

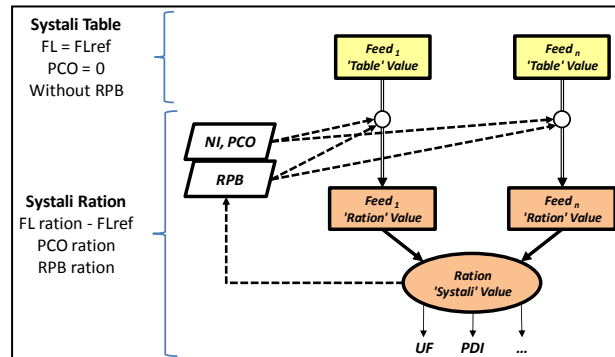


Figure 1 : Feed and ration evaluation in Systali project

FEED IDENTIFICATION										MAIN CRITERIA												
Num Trt	Code Publi	Code Trt	Feed Name	Feed Number	Code Inra	DMi % ration	Weight (de 0 à 1)	N 2007	Type	Name_INRA_2007	Criteria ->	25	28	53	33	56	47	124	137	69	128	161
						KgDM/d					Urea ->	OM	CP	Starch	NDF	EE	GE	OMd	NED	Ndr	STED	Ed
5	Doreau_1990	Rég 2 lact	Corn Silage	1	FE4730	64	1.0	FE4730	0	EN: Maïs, Hachage fin sans	Urea ->	958	71	353	439	30	4472	72.6	75.3	70.0	72.2	69.8
			Dehyd Beet Pulp	2	CF0170	30	0.3	CF0170	1	Pulpe de betterave déshydratée	Urea ->	936	91	0	454	10	4060	63.7	0.0	70.0	0.0	61.3
			Maize	3	CC0060	30	0.3	CC0060	1	Maïs	Urea ->	986	94	747	120	43	4463	82.6	56.3	85.0	0.0	76.9
			Barley	4	CC0010	30	0.3	CC0010	1	Orge	Urea ->	602	216	21	0	0	0	75.3	57.7	85.0	0.0	69.6
			Dehyd Alfalfa	5	CD0050	30	0.1	CD0050	1	Alfalfa déshydratée	Urea ->	0	379	34	0	0	0	87.6	86.6	90.0	61.4	84.7
			Minerals	6	CMV	30	0.0	CMV	1	CMV	Urea ->	0	0	0	0	0	0	80.9	14.1	90.0	58.9	77.4
			Formald Soyabean	7	CT0290	5	0.5	CT0290	1	Tourteau de soja tanné	Urea ->	927	516	0	139	21	4703	61.3	0.0	80.0	0.0	78.1
			Formald Rapeseec	8	CT0250	5	0.5	CT0250	1	Tourteau de colza tanné	Urea ->	921	380	0	319	26	4611	80.0	0.0	0.0	0.0	63.8
			Urea	9	CV0010	1	1.0	CV0010	1	Urée	Urea ->	1000	2875	0	0	0	2530	90.6	32.0	93.0	0.0	90.3
											Urea ->	68.3	31.0	81.0	0.0	0.0	0.0	75.6	33.0	81.0	0.0	73.4
											Urea ->	38.6	100.0	0.0	0.0	0.0	0.0	68.3	31.0	81.0	0.0	66.1
											Urea ->	1000	2875	0	0	0	2530	90.6	32.0	93.0	0.0	90.3

RATION PARAMETERS				RATION VALUES			
RPB iterative calculation Trt1	BY (Kg)	DMI (KgDM/d)	FLX:BV	PCO	RPB (g/KgDM)	gPDI/UF	UFL/d
-29	625	17.4	2.78	0.36	-29	-4	1.10
-65	17.4	2.78	0.36	-65	-4	-4	1.10
20	2.78	0.36	-29	20	-4	-4	1.10

Ration 'Table' Values = Σ FTV _{<i>i</i>} X _{<i>i</i>}												5b. Final Ration Values = Σ FRV _{<i>i</i>} X _{<i>i</i>}					
Publi	Trt	OM	CP	Starch	NDF	EE	GE	OMd	NED	Ndr	STED	Ed	OMd	NED	Ndr	STED	Ed
Doreau_1990	Rég 2 lact	946	139	336	373	28	4365	76.4	70.8	58.1	71.9	73.1	69.8	42.4	58.1	22.9	65.1
		0	0	0	0	0	0	-8.3	-28.3	0.0	-49.0	-8.0	69.8	1.7	-	-	-
		939	150	393	-	-	-	69.8	-	-	-	-	69.8	-	-	-	-

Figure 2 : Feed selection and specifications, extracted 'Table' values and calculated 'Ration' values for each trial of a publication (from Doreau et al., 1990)

- Systali final ration values, calculated without (yellow) or with (orange) DI, can be compared, and related to the observed measures in the publication (green) and/or to the INRA 2007 values (blue).
- The influence of FL, PCO and RPB can be weighted in the DI calculation according to the type of animal (Cattle vs Small ruminants). Their relative influence upon Omd are presented. Special attention is paid to the utilization of urea in the diet (Chapoutot et al., 3R 2013)

Conclusion

Systool: a regularly updated user-friendly tool, used to test and validate the Systali hypothesis in comparing the new model output with numerous scientific publication results (Nozière et al., EAAP 2013).