Smart farming applied to dairy cow feeding using NIR spectroscopy

EFFORT: Transition of dairy farms toward a better valorisation of forage ressources

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Introduction

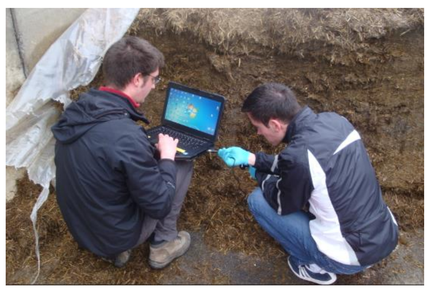
Currently, the time for feed analysis is often long and analyses are punctual while forage quality changes over time and space. One of the issues met by the farmers to feed animal is to check regularly the nutritional value of forages produced in the farm. In the framework of smart farming the Walloon Agricultural Research Center (CRA-W) is currently testing a new approach using NIR spectroscopy applied to the context of dairy farming in Wallonia, Belgium.

Objectif

Development of reliable, rapid and non-destructive analytical methods for predicting quality parameters such as dry matter (DM), chemical composition (Starch, Crude Proteins, ADF, NDF, Ash and Fat) and digestibility of wet forages directly on farm (specifically for maize silage, grass silage, fresh grass and hay).

TODAY

- **Shipping samples to the lab**
- **Annual analysis**
- **Send results to the farmer**
- **Database in the lab**



TOMORROW

- **Analyse on site**
- **Spatio-temporal analysis**
- **Results on site**
- **Local database**

Methodology

- **Fifteen dairy farms selected in Wallonia during the 2018 agricultural season to collect fresh samples**
- **Measure on site with three NIR portable: Nir4Farm (Aunir), Flame-NIR (OceanOptics), Field for Spec 4 (ASD)**
- **Measure in the lab with a XDS instrument (FOSS)**
- **Dataset calibration for building prediction models**
- **Database transfer from XDS to handheld NIR spectrometers**
- **Validation of models with another set of dairy farms during the 2019-2020 agricultural seasons (Dataset validation)**

Actual performances of NIR applied to fresh forages

In the past, models have been developed for fresh forages on benchtop XDS instrument (FOSS XDS). These models will be updated with the new fresh samples collected during the 2018 season and a transfer of database will be performed from FOSS XDS to the handhled NIR spectrometers to assess the potential of the portable system to predict quality parameters with a transfered database.

Table 1: Statistics of NIR fresh calibration for maize silage.

Parameters	N	Mean	SD	Est, Min	Est, Max	SEC	SECV	RPD
DM	817	34,45	6,41	15,21	53,69	1,46	1,59	4,39
CP	797	8,19	0,78	5,85	10,54	0,41	0,44	1,92
CEL	750	18,50	2,70	10,41	26,59	1,14	1,18	2,36
Ashes	769	4,60	0,74	2,37	6,83	0,29	0,31	2,55
Starch	790	34,12	6,17	15,61	52,63	2,52	2,61	2,45
In Vitro OM digestibility	768	74,68	3,91	62,93	86,42	1,70	1,80	2,31

Table 2: Statistics of NIR fresh calibration for grass silage.

Parameters	N	Mean	SD	Est, Min	Est, Max	SEC	SECV	RPD
DM	130	18,31	2,77	10,00	26,62	0,99	1,05	2,79
CP	694	19,21	4,42	5,94	32,48	1,39	1,48	3,18
CEL	692	23,80	2,48	16,37	31,24	0,98	1,03	2,53
Ashes	667	12,39	3,12	3,02	21,77	1,41	1,46	2,22
In Vitro OM digestibility	671	77,94	4,51	64,41	91,47	1,75	1,88	2,58

Handheld NIR spectrometers features

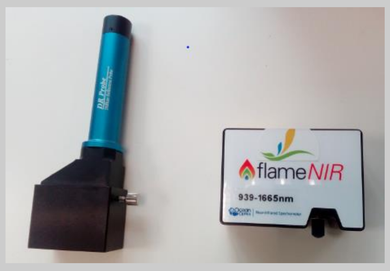
Nir4Farm (Aunir)

- **Diffuse Reflectance**
- **Contact probe**
- **Wavelength range: 910-1672 nm**

Field For Spec 4 (ASD)

- **Diffuse Reflectance**
- **Contact probe**
- **Wavelength range: 350-2400 nm**

Flame-NIR (OceanOptics)



- **Diffuse Reflectance**
- **Contact probe**
- **Wavelength range: 940-1665 nm**

Expected outcomes

The outcome of this project will be the development of an user-friendly tool for dairy farmers to predict on site the composition of their forages, enabling the calculation of their nutritionnal value and the adaptation of animal's feeding for a better sustainability.

Acknowledgments

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