

Characterization and detection of frass from *Tenebrio molitor* larvae by Near Infrared Spectroscopy techniques

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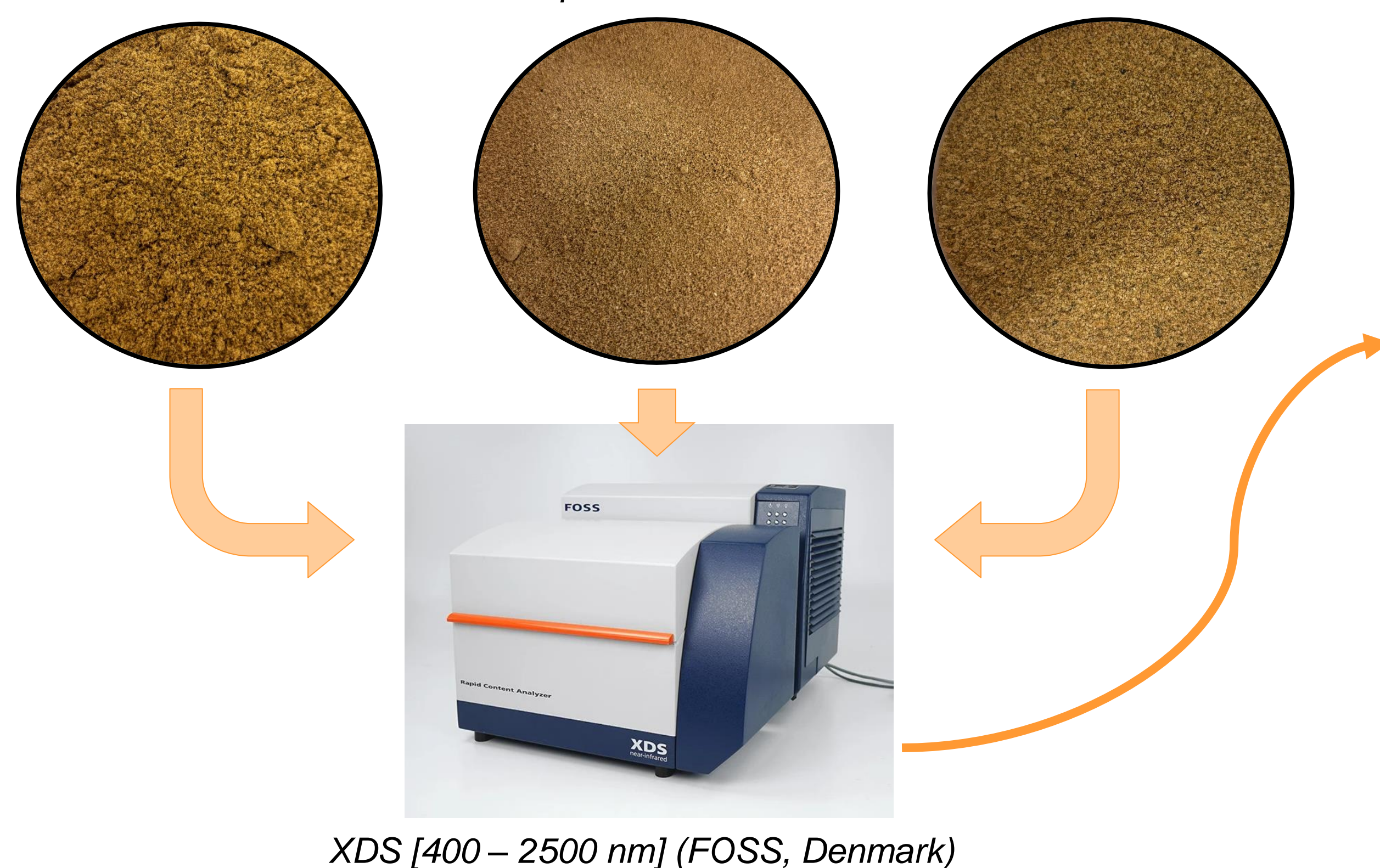
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Introduction

As defined by the European Commission (2021), frass is a mixture of insect excrement, food substrate, insect parts and dead eggs. In insect meal products, frass is prohibited but, due to its very dusty texture, it can be easily use to decrease the quality of insect products while maintaining the same information on composition and price. To date, no official methods have been developed for detecting frass in insect products. To address this issue, in a first step, Near Infrared Spectroscopy (NIRS) has been used to characterize a *Tenebrio molitor* (TM) larvae meal, a frass produced in-house, and a sample of TM larvae meal adulterated with 20% of frass. In a second step, NIR Microscopy (NIRM) was developed to detect the presence of two different frass (one produced in-house (HFr) and one commercial (CFr)) in a TM larvae meal at different levels of adulteration (5 %, 20 % and 50 %).

Predicting the composition of insect and frass samples by NIRS

TM larvae meal Frass produced in-house TM larvae meal + 20% frass



XDS [400 – 2500 nm] (FOSS, Denmark)

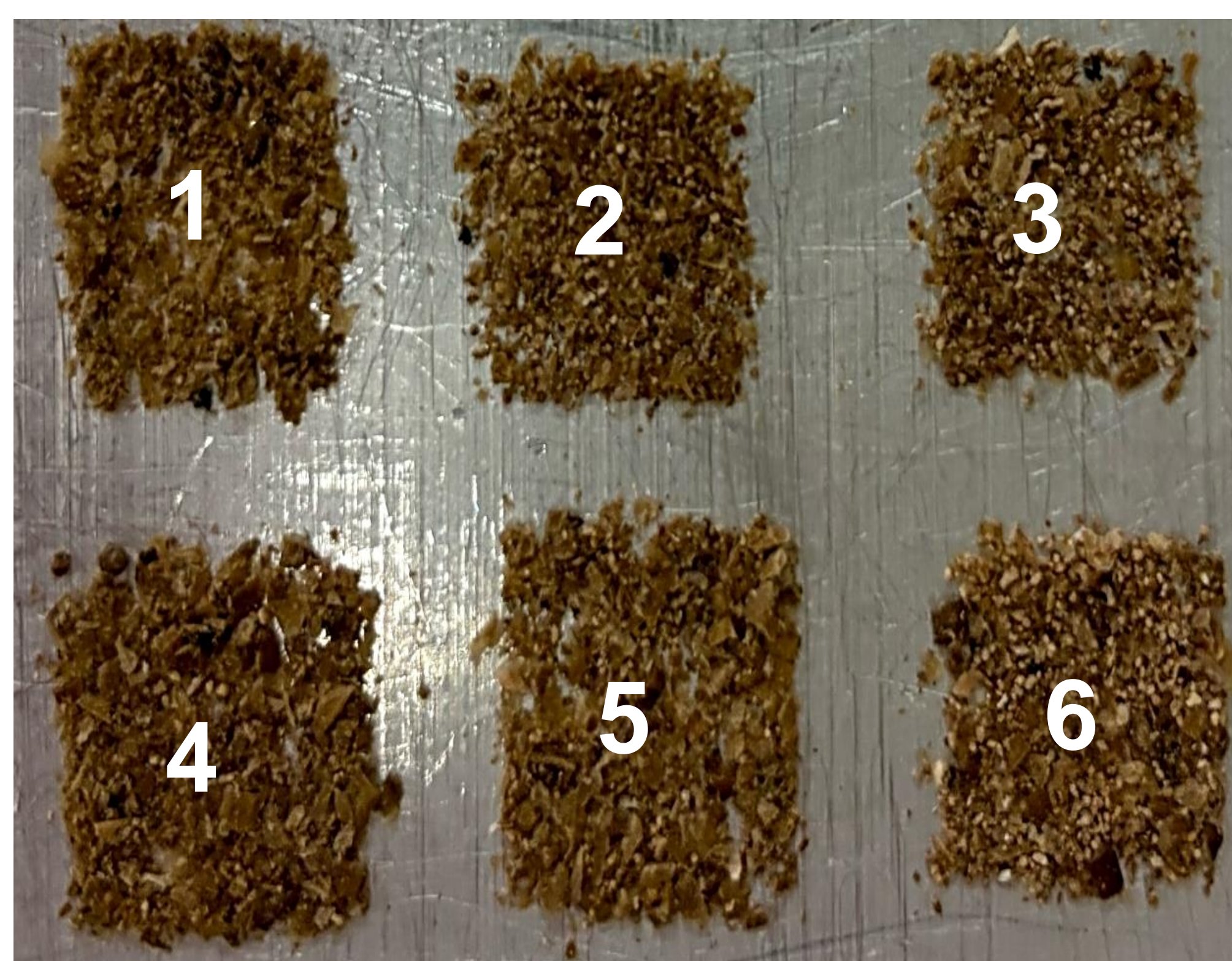
Sample	Humidity (%)	Protein (%)	Fat (%)	Chitin (%)	GH
TM larvae meal	6.57	63.29	7.52	9.73	0,70
Frass	10.58	15.91	- 0.63	5.16	4,61
TM larvae meal + 20% of frass	7.42	55.35	6.03	8.77	1,01
Standard Deviation	2.11	25.38	4.34	2.41	2,17
Total values	3	3	3	3	3

- **Protein** and **fat** contents of **frass** appears to be much **lower** than insect meal
- **Inclusion of frass** in TM larvae meal seems to **decrease** the **protein**, **fat** and **chitin** contents of the sample
- Need to compare results obtained with **reference values** to **improve prediction of frass** composition

Detection of frass in insect meal by NIRM

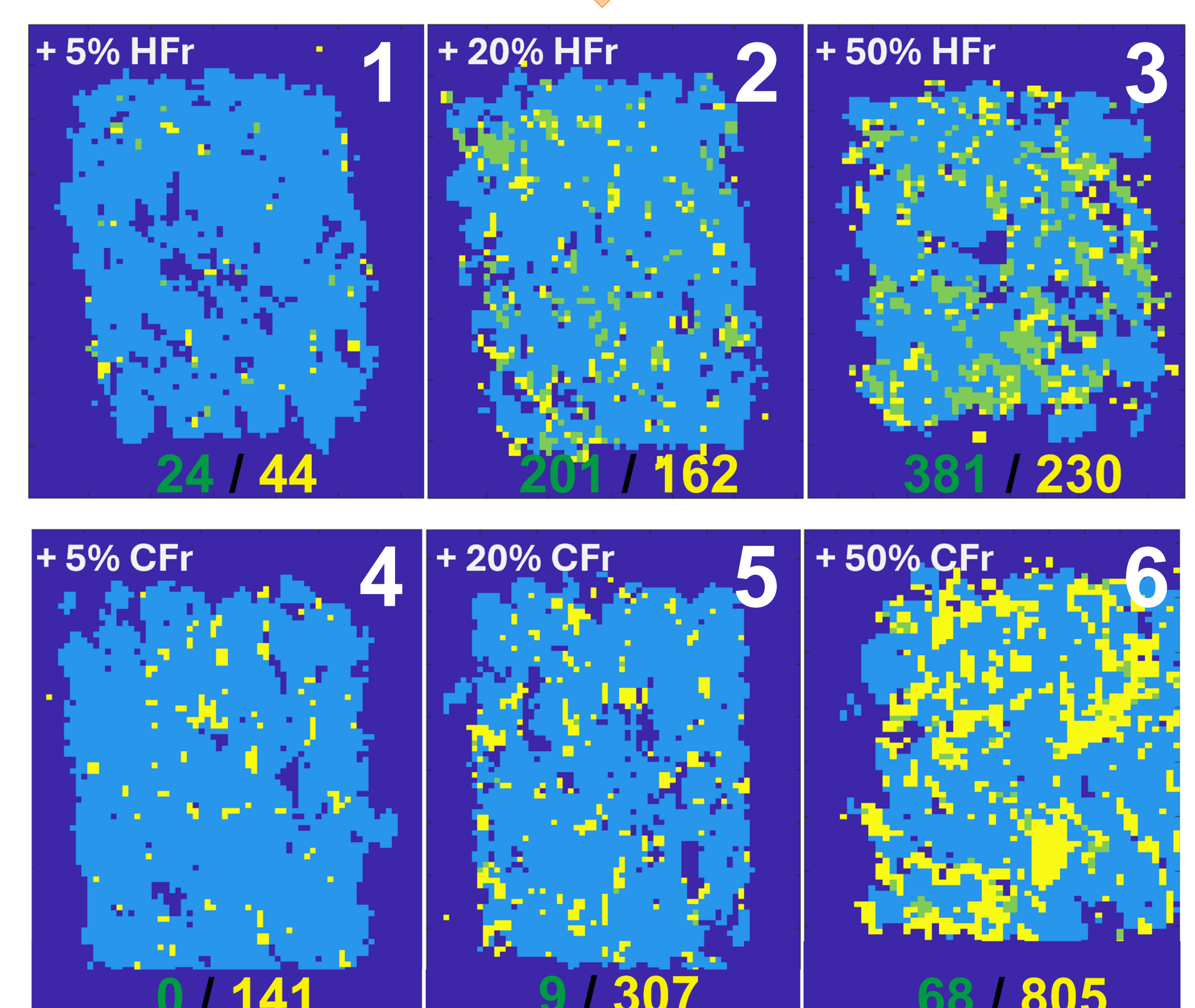
Photograph of the six samples of TM larvae meal adulterated with different levels of frass.

- 1: TM larvae meal + 5% of HFr
- 2: TM larvae meal + 20% of HFr
- 3: TM larvae meal + 50% of HFr
- 4: TM larvae meal + 5% of CFr
- 5: TM larvae meal + 20% of CFr
- 6: TM larvae meal + 50% of CFr



- **NIRM** combined with **chemometrics** can **detect** the **presence** of **frass** particles (HFr or CFr) in an insect meal regardless of the level of adulteration
- The percentage of frass detected by NIRM is lower than the actual percentage added to the insect meal
- **Confusions between HFr and CFr**, particularly in sample adulterated exclusively with HFr

Hyperion 3000 [1111 – 2500 nm] (Bruker, USA)



PLS-DA image processing of the six samples of TM larvae meal adulterated at different level with HFr or CFr. **Dark blue** : pixels classified as background; **Light blue**: pixels classified as TM larvae meal; **Green**: pixels classified as HFr; **Yellow**: pixels classified as CFr. Colored numbers correspond to the number of spectra classified as HFr (green) or CFr (yellow)

Conclusion & Perspectives

The different analyses carried out using **Near Infrared spectroscopy** techniques on frass samples have **enabled** us to assess its **chemical composition** and to **detect** it in **insect samples** at different level of adulteration.

Further analyses are required to improve the performance of the models, particularly for assessing composition. To achieve this, **chemical analyses must be carried out** on the frass samples. These chemical analyses will also provide a deeper understanding of the confusion observed between HFr and CFr.

The use of **Near Infrared spectroscopy** techniques represent **a first step** in evaluating the **quality of insect meal** to ensure safer control in the light of current legislation.