EARLY DETECTION OF CONTAMINANTS IN FEED MILLS BY NEAR INFRARED SPECTROSCOPY AND CHEMOMETRICS

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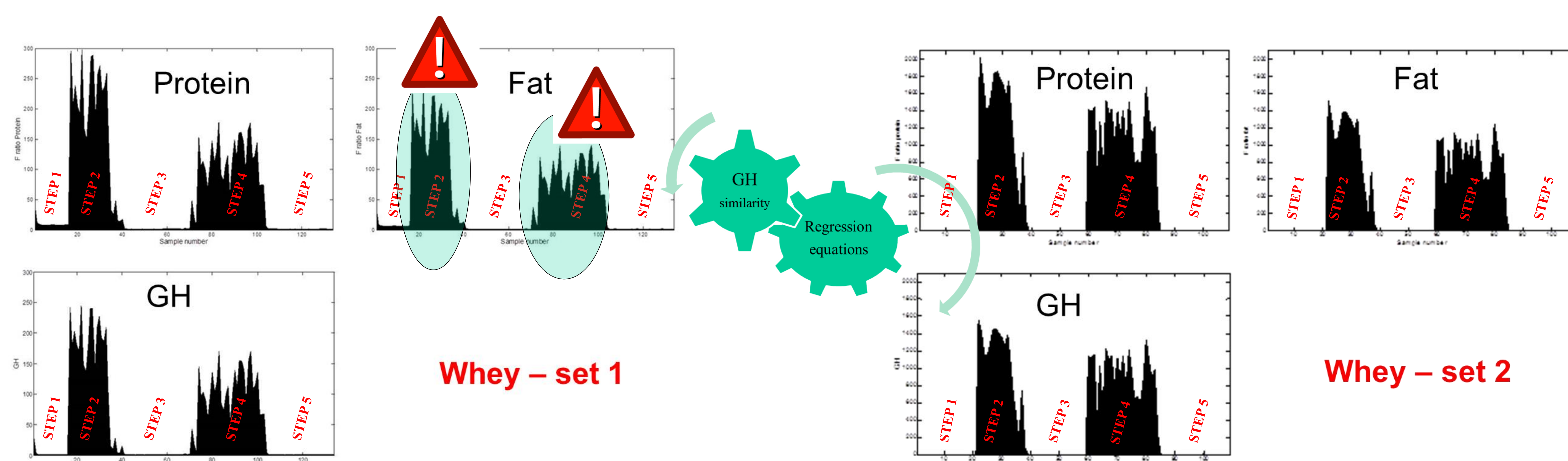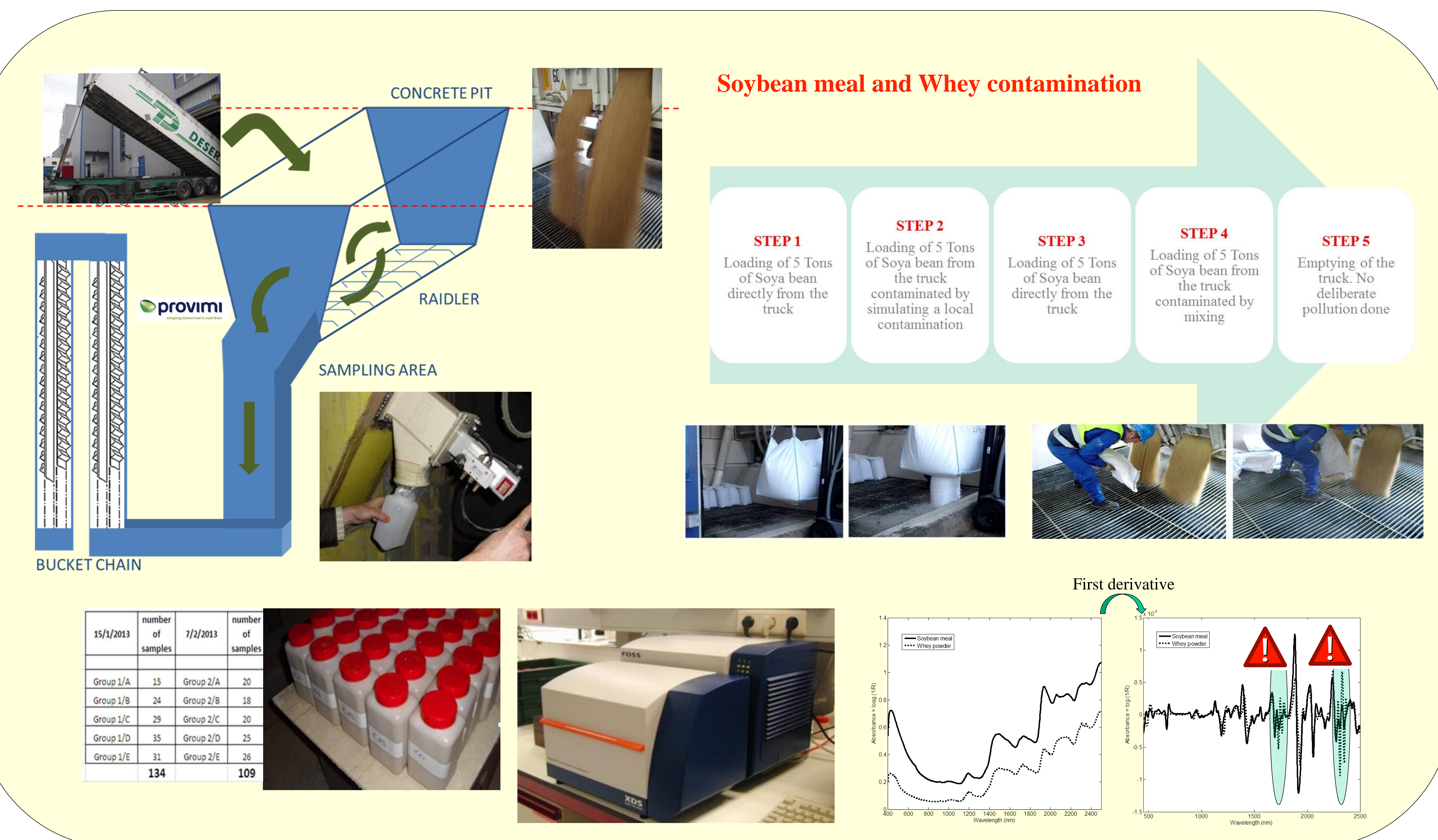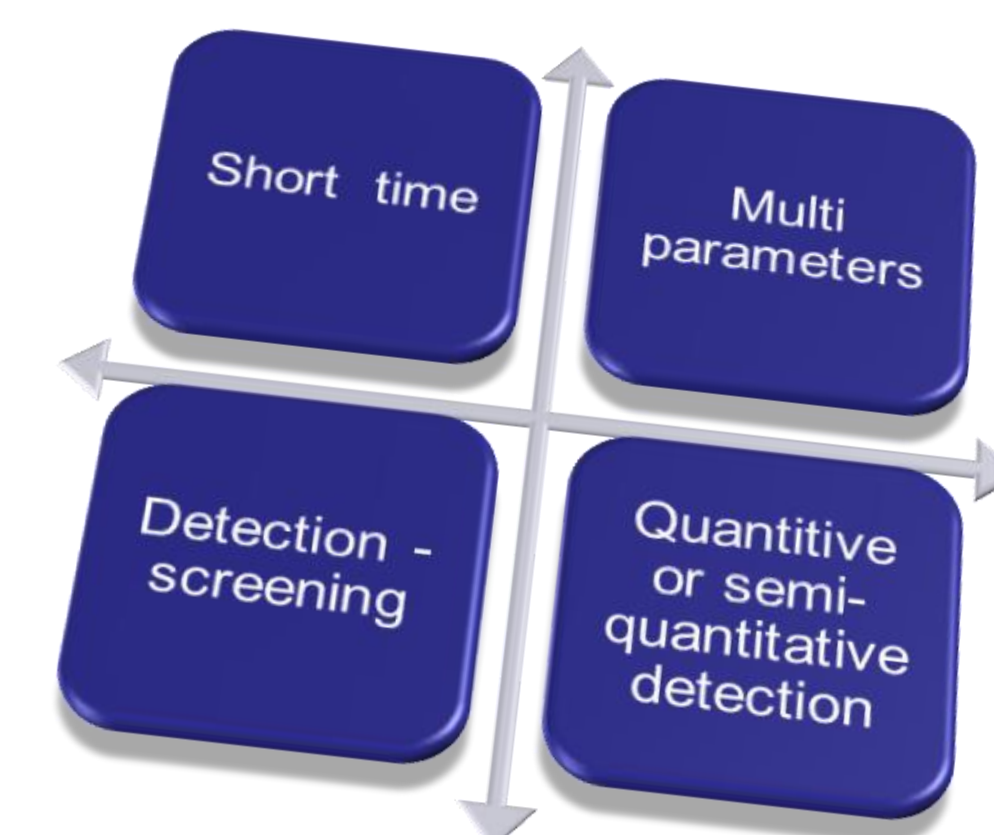
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Preventing Feed Outbreaks

In recent years, feed safety has become an increasing concern for consumers as a result of major crises related directly or indirectly to human health. The goal of this study is to develop a complete procedure based on Near Infrared (NIR) spectroscopy and chemometrics for characterizing typical feed ingredients and detecting the possible presence of contaminants from various origins directly at the entrance of the feed mill, preventing the contamination of the whole production chain. This study aims avoiding crises such as the recent melamine scandals in pet and human food commodities. The procedure proposed here has been validated at laboratory level on soybean meal samples contaminated with melamine and whey powder (milk serum). It was then adapted and used in a feed mill where two tests were performed at the reception of the raw material in order to detect anomalies arising from the addition of unusual ingredients or unauthorized additives.

The procedure proposed includes the use of vibrational spectroscopy and Chemometrics. Vibrational spectroscopy is used as accurate, rapid and sensitive analytical method needed for the assessment of the quality and safety of food and feed products. Chemometrics is needed for the creation of decision rules based on specifications. In this study, two chemometric approaches have been tested to detect the presence of abnormalities: i) the use of historical databases for fat and protein contents, ii) the GH or Mahalanobis criterion.

The complete procedure has been implemented in a large feed mill (Cargill Animal Nutrition) in order to detect anomalies due to an accidental or fraudulent addition of contaminant. All the efforts have been put on the setting of multivariate specifications for the NIR spectral characterization of pure soybean meal. The methodology has been tested with different trucks containing the soybean meal that were deliberated contaminated with whey during the loading at the entrance of the production chain. The results demonstrated the possibility to implement fast and efficient control strategy to detect on-line contamination (whatever the origin) at the discarding place.

Soybean meal and Whey contamination

STEP 1 — Loading of 5 Tons of Soya bean directly from the truck

STEP 2 — Loading of 5 Tons of Soya bean from the truck contaminated by simulating a local contamination

STEP 3 — Loading of 5 Tons of Soya bean directly from the truck

STEP 4 — Loading of 5 Tons of Soya bean from the truck contaminated by mixing

STEP 5 — Emptying of the truck. No deliberate pollution done

15/1/2013	number of samples	7/2/2013	number of samples
Group 1/A	15	Group 2/A	20
Group 1/B	24	Group 2/B	18
Group 1/C	29	Group 2/C	20
Group 1/D	35	Group 2/D	25
Group 1/E	31	Group 2/E	26
	134		109

First derivative

Whey – set 1

Whey – set 2

GH similarity — Regression equations

NIR spectroscopy in combination with chemometrics is the perfect tool, at laboratory, at feed mill and at port of entry levels, for the characterization of feed materials (as soybean meal) and the detection of targeted and untargeted adulteration / contamination.

Now, a NIR emission head, connected to a spectrometer via optical fiber, has been installed on the slope in between the horizontal conveyer and the elevator to collect spectra 'on the process'... at the entrance of the raw materials in the factory. Today, each raw material delivered in bulk is NIR scanned and a large number of NIR spectra per truck are collected.