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# ADVANTAGES OF USING ARTIFICIAL NEURAL NETWORKS CALIBRATION TECHNIQUES TO NEAR-INFRARED AGRICULTURAL DATA

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Artificial Neural Network (ANN) calibration techniques have been used commercially for agricultural applications since the mid-nineties. Global models, based on transmission data from 850 to 1050 nm, are used routinely to measure protein and moisture in wheat and barley and also moisture in triticale, rye, and oats. These models are currently used commercially in approx. 15 countries throughout the world. Results concerning earlier European ANN models are being published elsewhere. Some of the findings from that study will be discussed here.

ANN models have also been developed for coarsely ground samples of compound feed and feed ingredients, again measured in transmission mode from 850 to 1050 nm. The performance of models for pig- and poultry feed will be discussed briefly. These models were developed from a very large data set (more than 20,000 records), and cover a very broad range of finished products. The prediction curves are linear over the entire range for protein, fat, moisture, fibre, and starch (measured only on poultry feed), and accuracy is in line with the performance of smaller models based on Partial Least Squares (PLS). A simple bias adjustment is sufficient for calibration transfer across instruments.

Recently, we have investigated the possible use of ANN for a different type of NIR spectrometer, based on reflectance data from 1100 to 2500 nm. In one study, based on data for protein, fat, and moisture measured on unground compound feed samples, dedicated ANN models for specific product classes (cattle feed, pig feed, broiler feed, and layers feed) gave moderately better Standard Errors of Prediction (SEP) compared to modified PLS (MPLS). However, if the four product classes were combined into one general calibration model, the performance of the ANN model deteriorated only slightly compared to the class-specific models, while the SEP values for the MPLS predictions doubled.

Brix value in molasses is a measure of sugar content. Even with a huge dataset, PLS models were not sufficiently accurate for commercial use. In contrast, an ANN model based on the same data improved the accuracy considerably and straightened out non-linearity in the prediction plot.

The work of Mr. David Funk (GIPSA, U. S. Department of Agriculture) who has studied the influence of various types of spectral distortions on ANN- and PLS models, thereby providing comparative information on the robustness of these models towards instrument differences, will be discussed. This study was based on data from different classes of North American wheat measured in transmission from 850 to 1050 nm. The distortions studied included the effect of absorbance offset, pathlength variation, presence of stray light, bandwidth, and wavelength stretch and offset (either individually or combined). It was shown that a global ANN model was much less sensitive to most perturbations than class-specific GIPSA PLS calibrations.

It is concluded that ANN models based on large data sets offer substantial advantages over PLS models with respect to accuracy, range of materials that can be handled by a single calibration, stability, transferability, and sensitivity to perturbations.