

# **A single analytical platform for the rapid and simultaneous measurement of protein, oil and beta glucan content of oats using Near Infrared Reflectance Spectroscopy**

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Effective Near Infrared Reflectance Spectroscopy (NIRS) predictive calibrations were developed for simultaneous multiple component measurement of constituents (protein, oil and beta glucan content) in whole oat groats and ground oat groats. The use of whole oat groats as a starting material represents an advancement in the science as it precludes the need for sample grinding. Samples were collected from the 2015 and 2016 crop years from various locations in the United States (South Dakota, North Dakota, Washington, Iowa, and Wisconsin) representing a large geographical region and diverse genetic range (N=500). Predictive calibration equations were developed based on Modified Partial Least Square (MPLS) regression technique. Reference analyses were done by standard methods approved by AACCI and AOCS (AACCI method 32-23.01 for beta-glucan, AACCI method 46-30.01 for crude protein, AOCS Am 5-04 for oil content and AACCI method 44-15.02 for moisture content). The use of validation sample sets for each constituent, that were independent of samples used in NIRS calibration development, served as additional evidence of accuracy and precision.

High  $R^2$  and 1-VR and low SEC and SECV values provided evidence supporting the accuracy and precision of calibration models developed for beta-glucan, protein, and oil content estimation of oats. The NIRS Calibration for the estimation of beta-glucan content for ground oat groats yielded coefficient of determination ( $R^2$ ), standard error of calibration (SEC), standard error of cross validation (SECV) and one minus variance ratio (1-VR) ratio of 0.94, 0.16, 0.22 and 0.87, respectively. Protein calibration for ground oat groats showed  $R^2$ , 1-VR, SEC and SECV values of 0.94, 0.93, 0.61 and 0.64, respectively. Calibration employing ground oat groats for oil content estimation yielded high  $R^2$  and 1-VR values of 0.93 and 0.92 and low SEC and SECV values of 0.23 and 0.26, respectively.

Whole oat groat NIRS calibrations proved to be as effective as ground groat calibrations. Whole oat groats beta glucan calibrations showed excellent  $R^2$ , SEC, SECV and 1-VR of 0.93, 0.18, 0.23 and 0.89, respectively. For protein calibrations of whole oat groats,  $R^2$ , SEC, SECV and 1-VR values of 0.92, 0.70, 0.80 and 0.89, respectively were obtained. Oil content calibration with whole oat groats,  $R^2$ , SEC, SECV and 1-VR values were 0.90, 0.27, 0.30 and 0.88, respectively. This study showed that NIRS is an accurate and effective technology for oat quality measurement in plant breeding programs and in food processing.