Lubricant-Sensitivity Assessment of SPRESS® B820 by Near Infrared Spectroscopy: A Comparison of Multivariate Methods
V. S. Dave¹, C. Mack¹, H. Boyce², E. Ike-Amaechi², A. Al-Achi³, S. W. Hoag², R. V. Haware³
¹St. John Fisher College, ²University of Maryland, ³Campbell University College of Pharmacy and Health Sciences

Purpose
The aim of the present investigation was to compare the predictive performance of PCR and PLS calibration models based on near-infrared spectroscopy (NIRS) data used to monitor lubrication conditions impact on the tablet breaking force (TBF) of SPRESS® B820.

Methods
The impact of MgSt on lubrication of SPRESS® B820 was assessed by mixed experimental design. MgSt fraction, blending time, and compression force were chosen as a ‘design variables’, while TBF was used as a ‘response variable’. The lab-scale SPRESS® B820 samples (~500g) was lubricated with MgSt. The lubricated samples were compressed into tablets at various compression forces (500 mg, target weight), on a 10-station, instrumented rotary tablet press, equipped with standard bi-concave, unscored, 10 mm, B-tooling. Tablets were scanned in reflectance mode on a bench-top near-infrared spectrometer. TBF of NIR scanned tablets was measured using an automatic breaking force tester.

The collected raw NIR spectra were preprocessed before developing multivariate models. A qualitative and quantitative relationship between variables like lubricant concentration, blending time, compression force, NIR spectra from 1117.00 nm to 2499.50 nm, and tablet breaking force was modelled by principal component analysis (PCA), principal component regression (PCR), and partial least square (PLS) regression-1. The developed PCR and PLS calibration models were used to predict the tablet breaking force of an independent validation data set, which was not the part of the calibration models. A one-way ANOVA test was used to compare the differences between correlation coefficients of the measured and predicted TBF from the created PCR and PLS calibration models.

Results
The PCA score plot showed expected separation of SPRESS® B820 powder based on lubricant fraction and inverse correlation between MgSt blending time and tablet breaking force. The correlation coefficient between experimentally measured tablet breaking force and the tablet breaking force predicted from different PCR calibration models were 0.8804 (‘comprehensive or mixed’ PCR calibration model); 0.9684 (for samples containing 0.25% w/w MgSt); 0.9801 (for samples containing 0.50% w/w MgSt); 0.9189 (for samples containing 1.00% w/w MgSt). Similarly, the correlation coefficient between experimentally measured tablet breaking force and tablet breaking force values predicted from different PLS calibration models were 0.9216 (‘comprehensive or mixed’ PLS calibration model); 0.9681 (for samples containing 0.25% w/w MgSt); 0.9803 (for samples containing 0.50% w/w MgSt); 0.9849 (for samples containing 1.00% w/w MgSt). The correlation coefficients of ‘comprehensive or mixed’ PCR models for samples containing 1% w/w MgSt were significantly different from similar models based on PLS method (p <0.0001). On the other hand, differences between correlation coefficients of PCR model for samples containing 0.25% w/w and 0.50% w/w of MgSt were insignificant from PLS models for samples containing the same amount MgSt fractions (p >0.05).

Conclusion
The current study emphasizes a careful selection of multivariate calibration methods as well as lubrication fraction range during the calibration and validation stages, as it may have a significant impact on the prediction performance of the developed models.