Portable Near Infrared Instruments - A Comparison Study

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Abstract- **The fast progress in miniaturization of near infrared (NIR) spectrometer has taken advantage of technologies. We have developed a new technology enable of analyzing blood without blood - Progenos® instrument. Progenos® use NIR spectroscopy and chemometric algorithms to non – invasive blood analysis and is a portable instrument. In order to investigation the Progenos® effectiveness, we presents in this paper a comparison study between Progenos® and VIAVI MicroNIR®, a commercial equipment. These two equipment analyzed the same samples of a binary mixture containing white aluminum oxide and activated carbon and the data treated by chemometrics. Our study presented here showed that analytical results obtained with Progenos are the same as those obtained with the VIAVI MicroNIR® instrument. Therefore, Progenos® has all the necessary technologies and innovation to application in biochemical analyses.**

*keywords*聽- NIR; chemometrics; portable instruments.

INTRODUCTION

The fast progress in miniaturization of near infrared (NIR) spectrometer has taken advantage of new technologies and has to led a drastic reduction of spectrometer size and weight while allowing good performance due to the high precision implementation of important elements in the final device [1-2].

Blood analysis normally used in nowadays is costly, slow and brings discomfort to patients. Some papers describe non – invasive methods for analyzing blood using various techniques [3-6]. Nevertheless, the use of NIR spectroscopy associated with chemometrics deserves special mention for use as a non – invasive blood analytical method in humans [7].

Our company developed a new portable instrument, Progenos®, based in NIR spectroscopy and using chemometric algorithms to performed blood analysis without blood [8-9]. Based too in NIR spectroscopy, VIAVI MicroNIR® is a commercial equipment that has technological components originally developed for National Aeronautics and Space Administration (NASA) interplanetary spacecraft [10].

In order to investigation the Progenos® effectiveness, we present in this paper a comparison study between Progenos® and VIAVI MicroNIR®.

EXPERIMENTAL

INSTRUMENTATION

Progenos®, Nanotimize Company, has a plurality of photodetectors arranged in a circular gridded geometry that covers the wavelength range from 960 to 1600 nm.

VIAVI MicroNIR® 1700ES, Viavi Company, has an array detector that covers the wavelength range from 950 to 1650 nm and uses Linear Variable Filters (LVF) as a dispersant optical element.

NANOTIMIZE STANDARDS PREPARATION

The standards were prepared with the proportion of two types of powdered material: one in white (white aluminum oxide, Al_2O_3) and the other in black (activated carbon, C). Considering the appropriate proportions of each material, the samples were macerated and placed in a sample holder with a special glass window, generating standards of 2, 4, 6, 8 and 10% black material concentration.

SPECTRAL DATA ACQUISITION

The acquisition of spectral data of the same samples in both Progenos® and VIAVI MicroNIR® was performed in triplicate. The files generated in ".csv" format were exported to "Orange-Canvas", version 3.28, which runs on the Anaconda platform, in which all data processing was performed.

RESULTS

The model validation were carried out by cross-validation, data stratification, repetition of training and test data. In total, ten repetitions were performed with data stratification at 66%. The results are summarized in Tables 1 and 2.

Table – 1: Results of the analysis of the Nanotimize standards by Progenos® equipment.

Model	MSE	RMSE	MAE	R^2
Support Vector Machines	0.197	0.444	0.312	0.975
Partial Least Squares	0.062	0.249	0.158	0.992
Neural Network	0.053	0.231	0.137	0.993
Linear Regression	0.034	0.184	0.116	0.996

MSE = mean squared error; RMSE = root mean squared error; MAE = mean absolut error e R^2 = R-squared.

Table – 2: Results of the analysis of the Nanotimize standards by VIAVI MicroNIR® equipment.

Model	MSE	RMSE	MAE	R^2
Support Vector Machines	0.042	0.205	0.175	0.995
Partial Least Squares	0.043	0.207	0.173	0.995
Neural Network	0.063	0.250	0.193	0.992
Linear Regression	0.046	0.214	0.187	0.994

The observation, mainly, of column R^2 of Table 1 in comparison with Table 2 shows that the results obtained with the two equipments are equivalent.

CONCLUSION

The analytical results obtained with Progenos® are the same as those obtained with VIAVI MicroNIR® instrument. Therefore, Progenos® has all necessary technologies and innovation to application in biochemical analysis.

CONFLICT OF INTEREST

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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