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## Introduction

Sensory evaluation including appearance of green coffee is performed for qualitatively judging flavors of coffee. Expertise is necessary for the sensory panels, and evaluation is focused to on ensuring reliability. Recently, electric sensor systems have been developed to analyze taste, smell, and the appearance of foods. Instead of subjective evaluation, we have objectively evaluated the quality of coffee beans using electronic sensing systems.

## Materials/Methods

Eleven samples were prepared for this study. Of these eleven samples five were Guatemalan SHB coffee with distinctive flavors that were prepared from branded coffee from eight regions in Guatemala, while the others were non-branded Guatemalan SHB coffee<sup>1)</sup>. The green coffee was analyzed by E-Eye (IRIS) that was used to obtain detailed visual assessments of the color parameters of the overall beans. The light-roasted coffee was evaluated using two Q graders with SCAA cupping methodology<sup>2)</sup>. This method involves scoring on 10 attributes, and the maximum score of each attribute is 10 points. Specialty coffee is defined as coffee that receives a score of  $\geq 80$  points. E-Nose (HERACLES-II) was used to analyze the head space vapor of roasted and ground coffee samples with salting-out water. E-Tongue (ASTREE) was used to analyze the compounds dissolved in the liquids. All the equipment for the E-Sensing system was supplied by Alpha M.O.S, France. Statistical analysis between the SCAA cupping scores and the E-sensing data was conducted using their software.

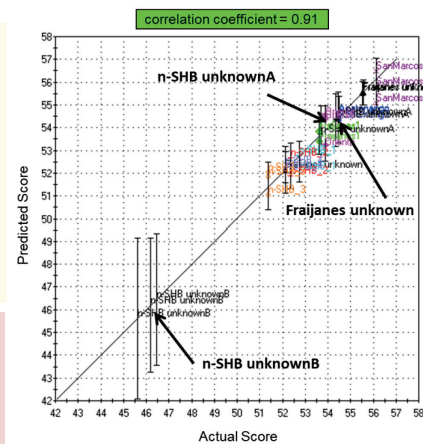


Figure 1: PLS regression model of SCAA cupping scores by E-Eye.

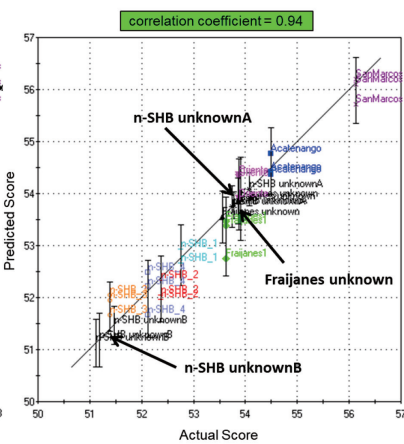


Figure 2: PLS regression model of SCAA cupping scores by E-Nose and E-Tongue.

## Results/Discussion

On developing the predictive model, three attributes (uniformity, clean cup, and overall), which were identified to not have a relationship with aroma and taste, were reduced for analysis. The border score as a Specialty coffee is approximately 53.5 points (full score 70.0) based on the previous experience of Q graders. Partial least squares (PLS) regression analysis indicated that the E-Eye data from the Guatemalan coffees were well correlated with the SCAA cupping scores of the Q graders. The coefficient of determination R<sup>2</sup> of the PLS regression analysis was 0.91. Moreover, the predictive model by the data of E-Nose and E-Tongue works well in verifying unknown Guatemalan SHB coffee. The coefficient of determination R<sup>2</sup> of the PLS regression analysis was 0.94.

## Conclusion/Perspectives

Analysis of coffee beans via E-sensing systems allowed the objective evaluation of specialty quality of the Guatemalan coffee beans. This rapid analysis by E-Eye and integration of E-Nose and E-Tongue must work effectively and facilitate reliable research and development, QC, and procurement.

Prediction results of model based on PLS regression analysis by E-Eye

	Actual	Specialty coffee	Predicted	Specialty coffee	Matching	Dif.
Fraijanes unknown	54.50	✓	54.41	✓	OK	-0.09
n-SHB unknownA	54.13	✓	54.17	✓	OK	0.04
n-SHB unknownB	50.88		46.08		OK	-4.80

Prediction results of model based on PLS regression analysis by E-Nose and E-Tongue

	Actual	Specialty coffee	Predicted	Specialty coffee	Matching	Dif.
Fraijanes unknown	54.50	✓	53.77	✓	OK	-0.73
n-SHB unknownA	54.13	✓	53.87	✓	OK	-0.26
n-SHB unknownB	50.88		51.26		OK	0.38

## References:

- 1) Nakai M, Sugiura M, Yajima T and Hiranuma K: Prediction of international standards cupping evaluation of Guatemalan Arabica coffee using electronic tongue and electronic Nose. *JPN J Taste Smell Res* Vol.21 No.3 PP.391-394 (2014)
- 2) SPECIALTY COFFEE ASSOCIATION OF AMERICA: Cupping Protocols. <http://www.scaa.org/?page=resources&d=cupping-protocols>