ASSESSING COFFEE BEANS QUALITY WITH E-SENSING SYSTEM

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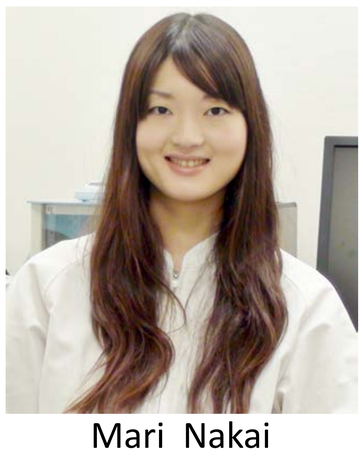
INTRODUCTION


Mari Nakai

Sensory evaluation is preferred owing to its empirical reliability and efficiency of quality assessment. However, sometimes it is difficult to verify quality on the basis of subjective evaluation. The component analysis of coffees using techniques such as gas chromatography (GC), high performance liquid chromatography (HPLC), and general analysis methods can be complicated and time-consuming. The E-sensing system of Alpha MOS (France) using AlphaSoft software provides a quick response in a short analysis time. In this study, the E-sensing system was assessed based on two sensory methods. The first is the global standard cupping method according to the Specialty Coffee Association of America (SCAA). The coffee beans defined as specialty coffee by this cupping have excellent aroma and taste. E-sensing analysis was studied to determine whether it could detect specialty grade coffee. The other method is a negative check by the sensory panels of a quality control (QC) group to seek off-flavor on screening samples. This QC cupping was verified for the analysis with an E-Eye.

MATERIALS

Guatemala coffees were used.

Branded coffee from eight regions and unbranded coffee were prepared. All were strictly hard bean (SHB) grade.

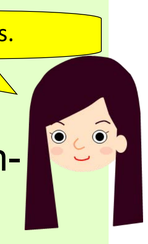
Roasted & Ground (R&G)

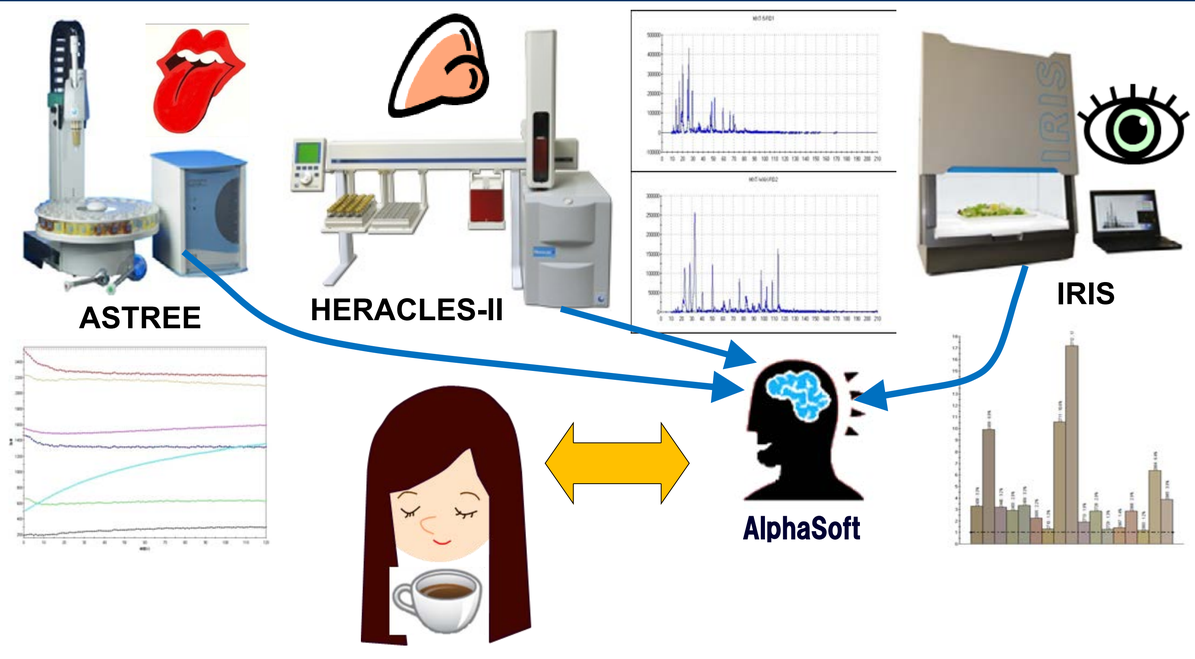
Light-roast. Five branded coffees of the eight regions and six unbranded coffees were prepared.

Eight regions in Guatemala Coffee

Green coffee

Fourteen unbranded coffee beans were prepared for calibration. Sixty eight of lot samples checked by QC panels for screening were evaluated for validation.





METHOD

SCAA cupping judge

The eleven samples of R&G were evaluated by two Q graders who have been trained in the international SCAA (*Specialty Coffee Association of America*) cupping methodology.

This method involves scoring for 10 attributes, each worth 10 points (total score: 100 points). ***Specialty coffee is defined as coffee that receives a score of 80 points or more***. *Upon building the predictive model, three attributes (uniformity, clean cup, and overall), which were found to not be related to aroma and taste, were reduced for analysis.* ***The border score as a Specialty coffee is around 53.5 points (full score 70.0) based on the past experience of Q graders.***

Table 1. SCAA cupping scores in base of all evaluation items and seven items focused on taste and aroma.

	Sample	Total SCAA Score	Total Taste and aroma	Quality
1	Acatenango	82.00	54.50	Specialty
2	Fraijanes1	80.88	53.63	Specialty
3	Oriente	80.25	53.88	Specialty
4	San Marcos	83.88	56.13	Specialty
5	n-SHB_1	79.75	52.75	Normal
6	n-SHB_2	79.38	52.38	Normal
7	n-SHB_3	78.25	51.38	Normal
8	n-SHB_4	78.88	52.13	Normal
9	Fraijanes unknown	82.00	54.50	Specialty
10	n-SHB_unknownA	81.50	54.13	Specialty
11	n-SHB_unknownB	77.38	50.88	Normal

Table 2. Evaluation items.

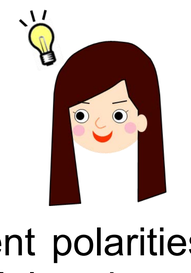
SCAA evaluation items	Taste and aroma items
Fragrance/ Aroma	Fragrance/ Aroma
Flavor	Flavor
Aftertaste	Aftertaste
Acidity	Acidity
Body	Body
Uniformity	Balance
Balance	Sweetness
Clean Cup	
Sweetness	
Overall	
each10points/ Total100points	each10points/ Total70points

QC check cupping for screening lot samples.

QC panels evaluate five cups of the light-roast coffees.

the score is (0) ; all cups have typical aroma and taste
(-1) ; in the case of slight un-uniform among five cups
(-2) ; a slight off-flavor is perceived

The more defects increases, the score is deteriorated. If the score is below (-3), it is determined as unacceptable.



Analysis

HERACLES-II (Alpha MOS, France) E-Nose

The GC instrument featured two columns with different polarities (MXT-5 & MXT-WAX, length = 10 m) mounted in parallel and coupled to two FIDs. The GC is also equipped with an automatic purge-and-trap system to improve sensitivity. Analysis time is 3.5 min.

Analyzing the head space vapor of R&G coffee samples with salting -out water incubated in a vessel at 80°C. The headspace vapor of 0.5g-ground coffee dipped in 5g-water with 1.5g NaCl from incubation in 20ml vial is analyzed.

ASTREE (Alpha MOS, France) E-Tongue

Analyzing compounds dissolved in liquids. The detection principle is based on a potentiometric measurement with seven ChemFET, i.e., chemical field-effect transistor, sensors. The filtrate of extract by boiled clean water of 120g for R&G coffee 10g is reacted with seven different sensor arrays for 2 min. It is measured the potential difference between Ag/AgCl electrode and each sensor.

IRIS (Alpha MOS, France) E-Eye

Visual assessments of the color parameters of Green coffee beans were achieved by CCD camera-based imaging system. The samples of 90g in a flat tray were analyzed.

RESULTS AND DISCUSSION

Good prediction for SCAA cupping judge by using *E-Nose and E-Tongue.*

Partial least squares PLS regression analysis indicated that the E-Nose and E-Tongue data from the Guatemalan coffees were well correlated with the SCAA cupping scores of Q graders. The coefficient of determination R2 of the PLS regression analysis was 0.88, indicating a good correlation. The predictive model works well for the verification of unknown Guatemalan SHB coffees.

Table 3. Calibrating results of a model based on PLS regression analysis of SCAA cupping scores. Prediction results of a model based on PLS regression analysis.

	Actual	Specialty Coffee level	Predicted	Specialty Coffee level	Matching
Acatenango	54.50	✔	54.80	✔	OK
Fraijanes1	53.63	✔	52.83		NG
Oriente	53.88	✔	53.92	✔	OK
SanMarcos	56.13	✔	55.84	✔	OK
n-SHB_1	52.75		53.23		OK
n-SHB_2	52.38		51.99		OK
n-SHB_3	51.38		52.02		OK
n-SHB_4	52.13		52.16		OK
Fraijanes unknown	54.50	✔	54.24	✔	OK
n-SHB unknownA	54.13	✔	53.86	✔	OK
n-SHB unknownB	50.88		51.96		OK

E-Eye works well for QC check cupping.

Fourteen samples were used for PLS regression analysis. The analysis indicated that the E-Eye data from Guatemalan SHB (unbranded) green coffees was well correlated with the sensory negative check results of QC panels. Four samples were selected as standards to meet each score of evaluation. The coefficient of determination R2 of the PLS regression analysis was 0.92. Sixty eight lots were evaluated for the validation. About 90% of lot samples was consistent with the estimation by the PLS regression analysis.

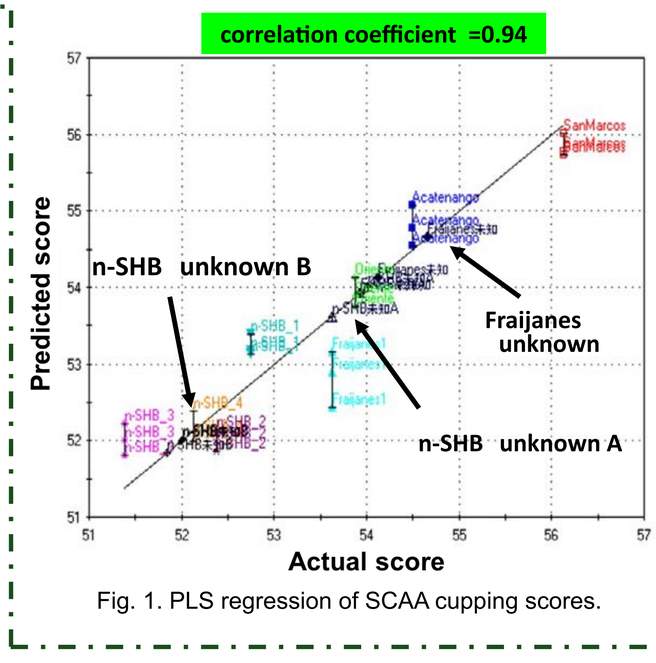


Fig. 1. PLS regression of SCAA cupping scores.

Table 4. A prediction example of a model based on PLS regression analysis of QC cupping scores.

	QC negative check score	Off-flavor	Predicted score
Lot sample 1	- 3	strong	- 2.7
Lot sample 2	- 1	slight	- 0.7
Lot sample 3	- 1	slight	- 1.2
Lot sample 4	0	nothing	- 0.3

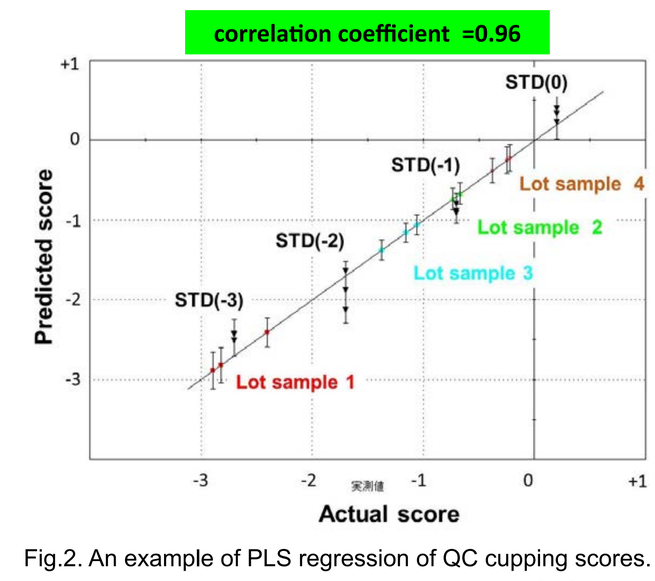


Fig.2. An example of PLS regression of QC cupping scores.

CONCLUSION

Clarifying the quality and flavor characteristics of coffee beans is important to properly manage quality control. The analysis of coffee beans using an E-sensing system comprising an E-Nose, E-Tongue, and E-Eye allowed the bean quality to be objectively assessed. This quick analysis using the E-sensing system will facilitate effective and reliable R&D, QC, and procurement.