Rapid Authentication of Coffee Bean Varieties of Different Forms by Using a Pocket-Sized Spectrometer and Multivariate Data Modelling

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OBJECTIVE

To check authentication and mislabelling of coffee varieties. A pocket-sized near infrared (NIR) spectrometer was used. NIR is known to be an advanced method for qualitative and quantitative analyses of food products due to efficient, low-cost, non-destructive properties. NIR requires minimal sample preparation time.

BACKGROUND

Arabica and Robusta coffee beans are distinguished by their physical properties in their raw state. However, once roasted, it can be difficult to distinguish the type of coffee. It is important to test and authenticate food and drinks to ensure consumers are getting the same product that is on the label.

METHODOLOGY

Two samples were collected of 130 beans of each kind of coffee. Each sample was cleaned and dried. Chemical properties of the samples were measured using standard recommendation reference analytical methods. The pocket-sized spectrometer was used to scan raw, roasted, and powdered samples of each variety. Processing methods were used to improve the data set (first and second derivative, mean centering, etc.). Principal component (PC) analysis was used by reducing data into a few variables to linear combine to detect trends.

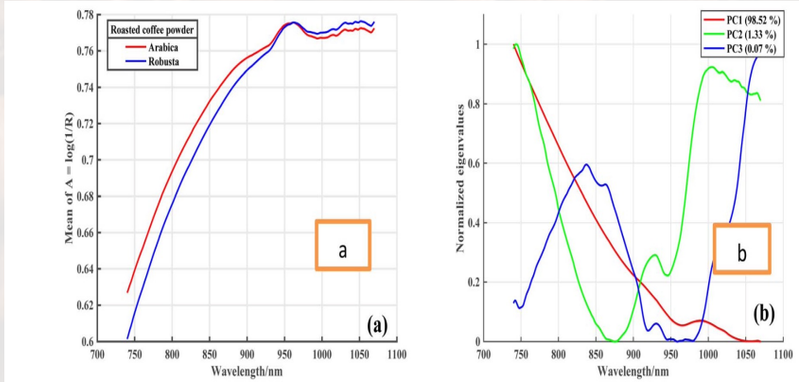

Fig. 6 Spectral profile (a) raw mean and (b) MC loading plot for roasted coffee powder.

FIGURE 1. MEAN SPECTRAL PROFILE AND PCA LOADING PLOT

DISCUSSION

1. **Authentication Methodology:**
   - Utilized pocket-sized spectrometer and chemometric analysis.
   - Implemented diverse preprocessing techniques and models
2. **Performance Metrics:**
   - Achieved high accuracy and efficiency in authenticating Arabica and Robusta coffee beans.
3. **Practical Application:**
   - Feasibility for on-the-go authentication using smartphones.
   - Rapid and non-destructive method for different coffee states (green, roasted, powdered).
4. **Chemical Parameter Changes**
   - Highlighted key changes in moisture content, ash content, protein, carbohydrates, lipids, polyphenols, and antioxidant activity from raw to roasted.

RESULTS

Chemical Parameter Results:
Moisture Content: 7%-8% for raw, 4%-5% for roasted.
Ash Content: 4%-5% for raw, 3%-4% for roasted.
Protein: Decreased from raw to roasted. *Carbohydrates:* Decreased from raw to roasted.
Lipids: Increased from raw to roasted. *Polyphenols:* Decreased from raw to roasted. *Antioxidant Activity:* Increased from raw to roasted.

FUTURE WORK

Future studies are required to authenticate regional and geographical origins of coffee beans, and an improvement to the study could be increasing the sample size of the raw, roasted, and powdered coffee beans for each variety.

REFERENCE

Boadu, V et al.; Rapid authentication of coffee bean varieties of different forms by using a pocket-sized spectrometer and multivariate data modelling. Analytical Methods. 2022, Issue 46, 4741-4904. DOI: 10.1039/d2ay01480g

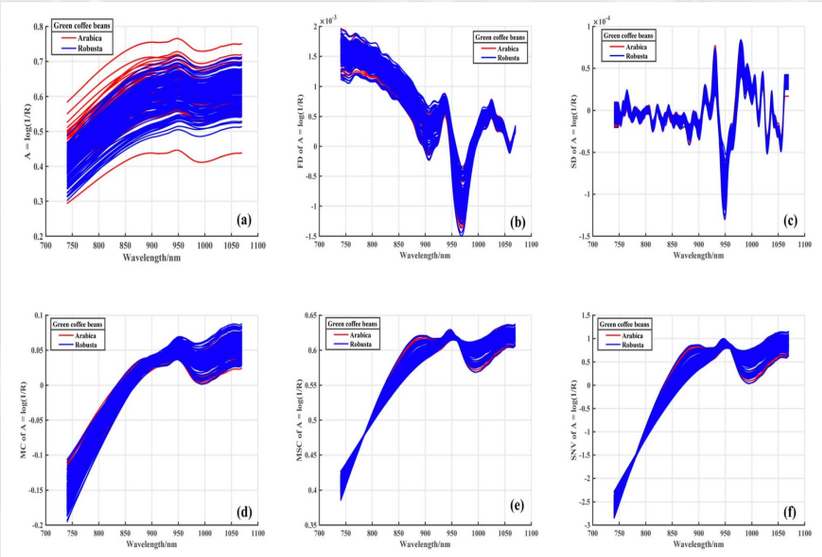

Fig. 1 Spectral profiles of green coffee beans (a) raw, (b) FD, (c) SD, (d) MC, (e) MSC and (f) SNV.

FIGURE 2. SPECTRAL PROFILE OF RAW BEANS

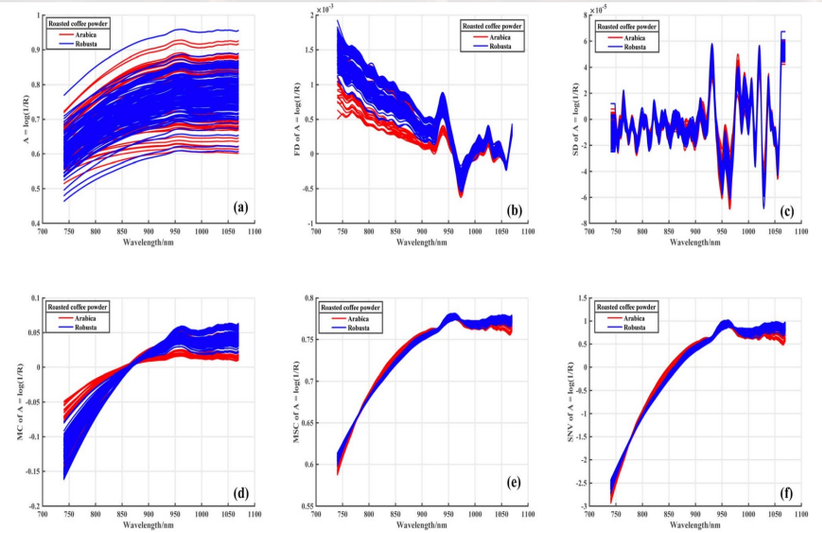

Fig. 2 Spectral profiles of roasted coffee powder (a) raw, (b) FD, (c) SD, (d) MC, (e) MSC and (f) SNV.

FIGURE 3. SPECTRAL PROFILE OF ROASTED BEANS