18th Meeting of the Portuguese Electrochemical Society

Sociedade Portuguesa de Electroquímica

25th-27th March 2013

Porto, Portugal

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Departamento de Química e Bioquímica
Faculdade de Ciências da Universidade do Porto
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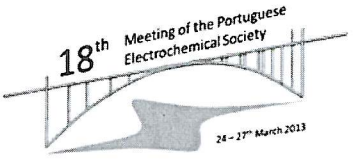

Title

18th Meeting of the Portuguese Electrochemical Society

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P3. Discrimination of monofloral honeys using a potentiometric electronic tongue

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There is a commercial interest in selling honey according to its color and pollen classification because the pollen content is related to the honey quality [1]. The honey color classification is expressed in the Pfund scale (mm), based on absorbance readings at 560 nm, and ranges between extra-white and dark [2].

The objective of this work is to investigate whether a potentiometric electronic tongue (E-tongue) is able to classify honeys according to their three main colors (white, amber and dark) and to discriminate between monofloral honeys within each of these groups.

The E-tongue had an Ag/AgCl reference electrode with double junction, and a multi-sensor device with 20 chemical sensors, based on all-solid-state electrodes with lipid polymeric membranes formed on solid supports of conducting silver. Two identical systems of multi-sensors were used, which allowed recording a profile of 40 signals for each sample. Honeys samples (65), provided by the National Federation of Beekeepers of Portugal, were classified according to the color (spectrophotometric method), pollen profile composition (microscopic method) and also analyzed using the E-tongue.

The honeys of each group contained the following monofloral honeys: white honeys (20 samples), *Lavandula sp.* or *Echium sp.*; amber honeys (30 samples), *Lavandula sp.*, *Echium sp.*, *Prunus sp.* or *Rubus sp.*; dark honeys (15 samples), *Castanea sp.*, *Erica sp.* or *Rubus sp.*

The data were treated by linear discrimination analysis (LDA) using forward stepwise variable selection and the leave-one-out cross-validation technique.

Selected E-tongue signals together with LDA allowed 100%, 90% and 80% of correct classifications of monofloral honeys within the amber, white and dark groups, respectively.

The results showed that the E-tongue can be used as a practical tool for discriminating monofloral honeys, though more robust classifications are expected by using different heuristic techniques for variable selection.

[1] W Von Der Ohe, LP Oddo, ML Piana, M Morlot and P Martin, *Apidologie*, 2004, 35, S18–S25
[2] GF Townsend, *J Apic Res*, 1969, 8, 29-36

Discrimination of monofloral honeys using a potentiometric electronic tongue

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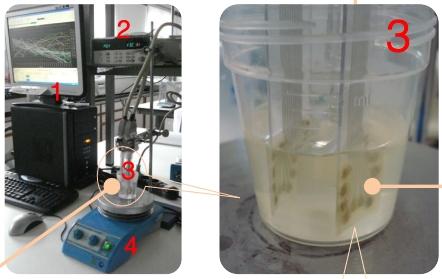
ELECTRONIC TONGUE
(taste sensor array)
↓
Chemical sensors with high stability and cross sensitivity to different species in solution
↓
OBTAIN
signal pattern which corresponds to the overall information on the sample
↓
APPLY
chemometric methods
↓
ALLOW
sample identification/classification
taste evaluation
multicomponent analysis

POTENTIOMETRIC DEVICE
(all-solid-state electrodes)
↓
20 lipid polymeric membranes
Ag/AgCl reference electrode



MULTI-SENSOR ANALYTICAL SYSTEM:
1 - PC for data acquisition;
2 - DataLogger Agilent;
3 - Etongue device;
4 - Magnetic stirrer.

Analysis with two sensor arrays: 40 sensors

COMPOSITION OF
LIPID POLYMERIC MEMBRANE:
31.9-32.3% of PVC
64.7-65.2% of one of the plasticizers
2.8-3.2% of one membrane additive

MEMBRANE ADDITIVE SUBSTANCE

[1] Octadecylamine
[2] Oleyl alcohol
[3] Methyltrioctylammonium chloride
[4] Oleic acid

PLASTICISER SUBSTANCE

[A] Bis(1-butylpentyl) adipate
[B] Dibutyl sebacate
[C] 2-Nitrophenyl-octylether
[D] (2-ethylhexyl)phosphate
[E] Dioctyl phenylphosphonate

65 HONEY SAMPLES
↓
Honey sample dissolved in water
(10g per 50 mL of H_2O)

OBJECTIVES

ELECTRONIC TONGUE ANALYSIS
↓
CLASSIFY honeys according to 3 main colors
↓
DISCRIMINATE monofloral honeys for each color group
↓
COMMERCIAL INTEREST

POLLEN ANALYSIS
↓
MICROSCOPIC METHOD
↓
POLLEN PROFILE
↓
6 MAIN TYPES OF POLLEN

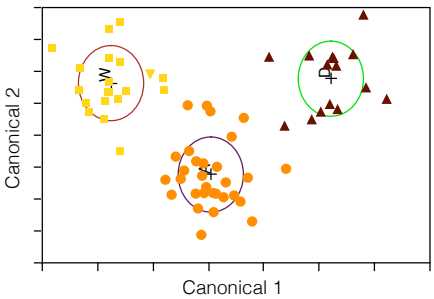
COLOR ANALYSIS
↓
SPECTROPHOTOMETRIC METHOD
↓
PFUND SCALE (mm)
↓
WHITE
AMBER
DARK

RESULTS OF COLOR AND POLLEN ANALYSIS

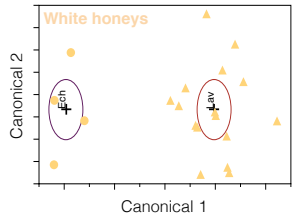
COLOR	MONOFLORAL HONEYS
WHITE (20 samples) →	(16) *Lavandula sp.* (4) *Echium sp.*
AMBER (30 samples) →	(5) *Lavandula sp.* (11) *Echium sp.* (3) *Prunus sp.* (11) *Rubus sp.*
DARK (15 samples) →	(4) *Castanea sp.* (8) *Erica sp.* (3) *Rubus sp.*

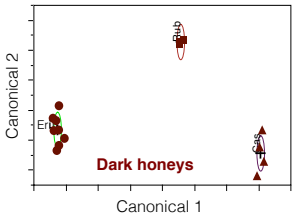
ELECTRONIC TONGUE RESULTS: MULTIVARIATE ANALYSIS

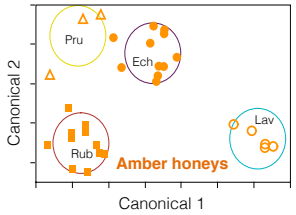
LINEAR DISCRIMINANT ANALYSIS (LDA) OF THE 3 MAIN COLORS



LDA WITHIN EACH COLOR GROUP
↓
DISCRIMINATING MONOFLORAL HONEYS
↓
STEPWISE VARIABLE SELECTION
↓
LEAVE-ONE-OUT CROSS-VALIDATION







LEAVE-ONE-OUT LDA CORRECT CLASSIFICATIONS:

WHITE – 90%
AMBER – 100%
DARK – 80%

Acknowledgements: Collaboration of the Portuguese National Beekeepers Federation in providing honey samples is gratefully acknowledged.

CONCLUSION

THE PROPOSED APPROACH CAN BE USED AS A PRACTICAL TOOL FOR DISCRIMINATING MONOFLORAL HONEYS.