Optimization of the Measurement Parameters of the Electronic Tongue for the Classification of Different Fat Content Trappist Cheese

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INTRODUCTION

Cheese flavor highly depends on both its volatile and nonvolatile compounds such as peptides, amino acids, fats and salts. The characteristics of the end-product depends on the quality of the milk and the ripening method affecting the microbiological, organoleptic and physical-chemical properties. E-tongue providing simultaneous multi-component quantitative determination along with qualitative discriminatory capacities is considered to be a good alternative to classical laboratory techniques because of its high sensitivity, low cost, simple operation, and inherent portability.

This work aimed to determine the optimal parameters (solutions' concentration and the sequence order) defined by the method, in order to improve the performance of the method for discrimination of cheese, influenced by selectivity and sensitivity aspects of the sensors array.

MATERIALS AND METHODS

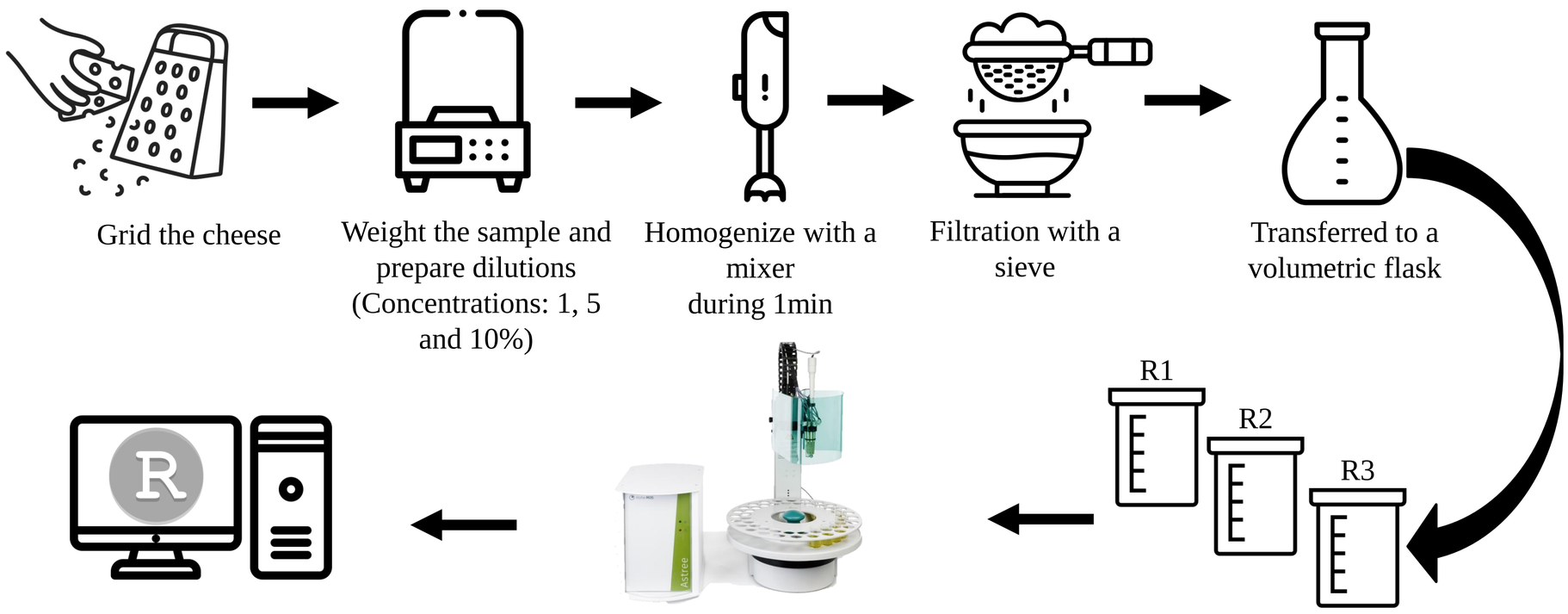
Trappista Cheese – 5 Brands

- RI (Riska) 19g of fat/100g
- CH (Cheeseland) 22g of fat /100g

Lower Fat Content

- FI (Fino) 25g of fat /100g
- TE (Tesco) 26g of fat /100g
- TO (Tolle) 26g of fat /100g

Higher Fat Content



Measurement sequences

- 1st sequence: CH, RI, TE, TO and FI
- 2nd sequence: RI, CH, TO, FI and TE
- 3rd sequence: CH, TE, RI, FI and TO

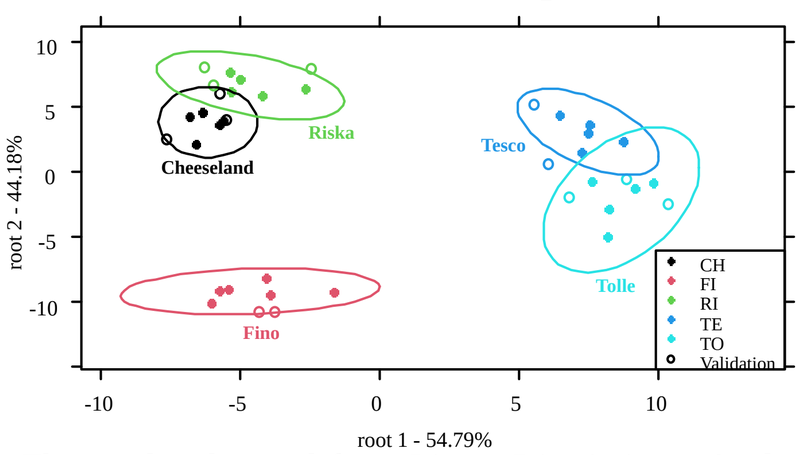
Data evaluation using RStudio software (4.1.1 version) in order to accomplish the multivariate data analysis (PCA, LDA)

Analysis performed via electronic-tongue ("α-ASTREE" Liquid and Taste Analyzer - Alpha M.O.S., Toulouse, France)

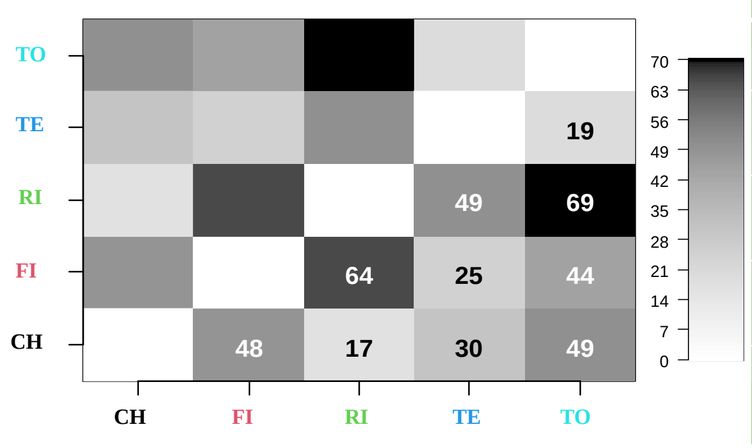
Divided in 3 replicates. One concentration was performed per day: 3 different measurement sequences of 3 replicates from each cheese brand (n = 45)

RESULTS

Linear Discriminant Analysis (LDA) Model Cheese 10%, 2nd sequence



Euclidean Distances (ED) Cheese 10%, 2nd sequence



Summary of LDA confusion tables for classification

	Cheese 1% concentration		Cheese 5% concentration		Cheese 10% concentration	
	Recognition	Prediction	Recognition	Prediction	Recognition	Prediction
1st sequence	66.29	40.00	84.99	70.48	92.50	82.53
2nd sequence	98.35	56.78	97.52	87.52	**97.52**	**95.04**
3rd sequence	97.52	80.02	98.76	90.07	94.98	90.02
Average accuracies	87.39	58.93	93.76	82.69	95.00	89.19

- The results observed from Linear Discriminant Analysis and Euclidean Distances proves the similarities between RI and CH (lower fat content), in comparison to the other three samples (FI, TE and TO) of high fat content.
- Even though the best LDA model found was 10% concentration, it is recommendable to work with the reduced concentration of 5% considering the integrity of the equipment.
- According to the best sequence, considering the 10% optimal defined cheese concentration, both second and third sequences perform good, being the 2nd sequence slight better for this concentration (RI, CH, TO, FI and TE).

CONCLUSIONS

- This study has shown that discrimination of cheese can be optimized by selecting specific parameters such as:
- Concentration: capability of e-tongue to discriminate between samples improves over higher concentrations (10%).
- Measurement sequence: e-tongue had better performance when samples are analyzed per groups, considering the two with lower fat content first and then the three samples with higher fat content.
- Due to the impact of the matrix, lower concentrations are recommended considering the deterioration of sensors within time.

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