The importance of methodological adaptation to get reliable results in sensory evaluation of product presenting biological variability:

a case study on apple

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Introduction

Sensory profiling is a strategic tool to manage product quality and precise what is expected by consumers. A standard analysis of variance (ANOVA), including fixed product effect, random assessor effect and interaction (random) is often used to analyze sensory data. However this model may not be the best to handle all types of data. For example, in sensory evaluation of product presenting biological variability, the variability of the response is due to both individual differences between assessors and product heterogeneity.

Objective

The objective of the present study was to compare results from two models of analysis of variance and look into consistency gain when including a factor that takes biological variability into account.

Material & Methods

Descriptive Sensory analysis

➥ 3 cultivars (18 apples per cultivar)

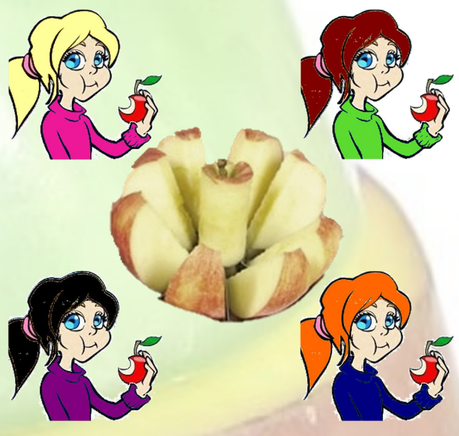
➥ 19 trained assessors divided in 6 sub-panels (3-4)

➥ 7 descriptors : *Crunchiness*, *Firmness*, *Crispness*, *Juiciness*, *Fondant*, *Acidity* & *Sweetness*; evaluated on an unstructured scale (0=not, 10=extremely)

➥ 3 replicates

Tasting procedure

Each apple is divided into 4 portions, in that way each individual apple is scored by several assessors



Statistical analysis

Main objectives of ANOVA: identify and quantify the factors responsible for the variability of the response

Standard model

$$Y_{ijk} = Cultivar_i + Assessor_j + Cultivar{:}Assessor_{ij} + \varepsilon_{ijk} \quad (1)$$

Model that takes biological variability into account

$$Y_{ijk} = Cultivar_i + Assessor_j + Cultivar{:}Assessor_{ij} + Fruit_{I(i)} + \varepsilon_{ijk} \quad (2)$$

Analyses were run with `lmerTest` package in R 2.15.1 [1]

Results

The fruit contribution is major

➥ Larger than the assessor contributions

➥ Larger than the cultivar contribution (e.g. for *juiciness*)

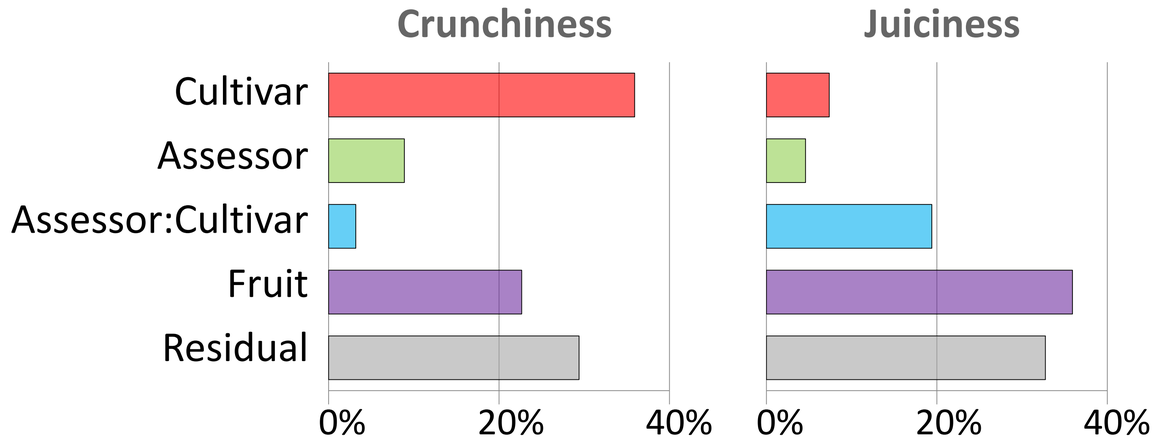


Fig. 1. Contribution to variance for *crunchiness* and *juiciness* [%]

Conclusions about product differences may change

➥ The discrimination decreases when the biological variability is taken into account

Table 1. p value of the two model situations for cultivar effect

Signif. code:

p < 0.05

p < 0.01

p < 0.001

	Model (1)	Model (2)
Crunchiness	1.02E-14	2.89E-07
Firmness	2.76E-19	1.11E-09
Crispness	3.00E-06	3.00E-06
Juiciness	1.02E-03	6.56E-02
Fondant	4.85E-15	3.18E-06
Acidity	3.20E-03	4.72E-02
Sweetness	2.58E-09	2.58E-09

Conclusion & Perspectives

The fruit contribution to variance appears to be an important factor of variability. Including a factor to take the biological variability existing within each sample in the ANOVA is relevant, and is possible if and only if each sample is tasted by several assessors. So, for the characterization of products presenting biological variability, samples should be shared by several assessors in order to provide more reliable sensory results. The adaptation of sensory protocols and data analysis are here pointed out as key-points for the reliability of sensory results. As a perspective the model proposed to take biological variability into account may be combined with Mixed Assessor Model [2]. This procedure might be extended to any product presenting biological variability, such as vegetables, dairy products, cheeses…

References [1] Kuznetsova, A., Christensen, R.H.B., Bavay, C., Brockhoff, P.B., (2012). Automized Mixed ANOVA Modelling of sensory and consumer data. In 11th Sensometrics, 10-13 July 2012, Rennes, France

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