Determination of orthonasal and retronasal detection thresholds in a model alcohol-free beer: Comparison of calculation methods

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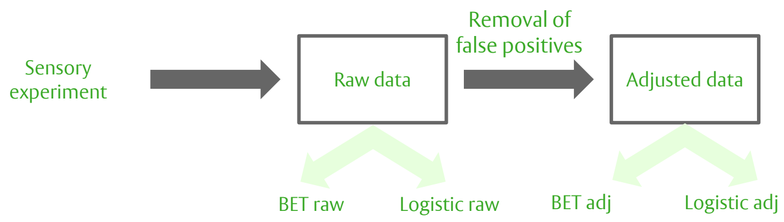
Introduction

The composition of a food matrix, such as ethanol or sugar content, has an impact on the release of flavour compounds, and thus on detection thresholds (DT) [1]. Hence, DTs determined in water or ethanol solutions might not be suitable for alcohol-free beers (AFB).

The aim of this study is to determine detection thresholds of aroma compounds in an artificial AFB-like matrix, as well as to compare the effect of the calculation method on the final threshold value.
To do so, thresholds were calculated using two different methods (Best Estimated Threshold and Logistic regression), from both raw data and adjusted data for the removal of false positives.



Materials and methods

Experimental design:

Six concentrations in ascending order (3 blabla)

The matrix was composed of a mixture of sugars (40.4 g/L) in carbonated water:

- Glucose (7.2 g/L), fructose (2.1 g/L), maltose (26.9 g/L), sucrose (0.06 g/L), maltotriose (3.6 g/L)

3-AFC (alternative forced choice): 1 sample and 2 blanks per level of concentration.

24 experienced panellists were asked to both sniff and taste the samples.

The panellists' responses were collected using Compusense sensory analysis software.

Calculation methods and data analysis

Best Estimated Threshold (BET)

Concentration	1 mg/L	3 mg/L	9 mg/L	27 mg/L
Difference perceived?	No	**No**	**Yes**	Yes

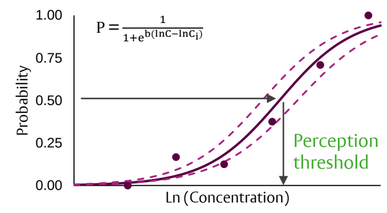
Geometrical mean

$$BET = \sqrt[2]{C_n \cdot C_{n+1}} = \sqrt[2]{3 \cdot 9} = 5.19 \text{ mg/L}$$

BET is calculated as the geometrical mean of the concentrations for the higher negative response and the next positive one [2].

Logistic regression

Thresholds were calculated as the concentration at which 50% of the panellists gave a correct response [1].

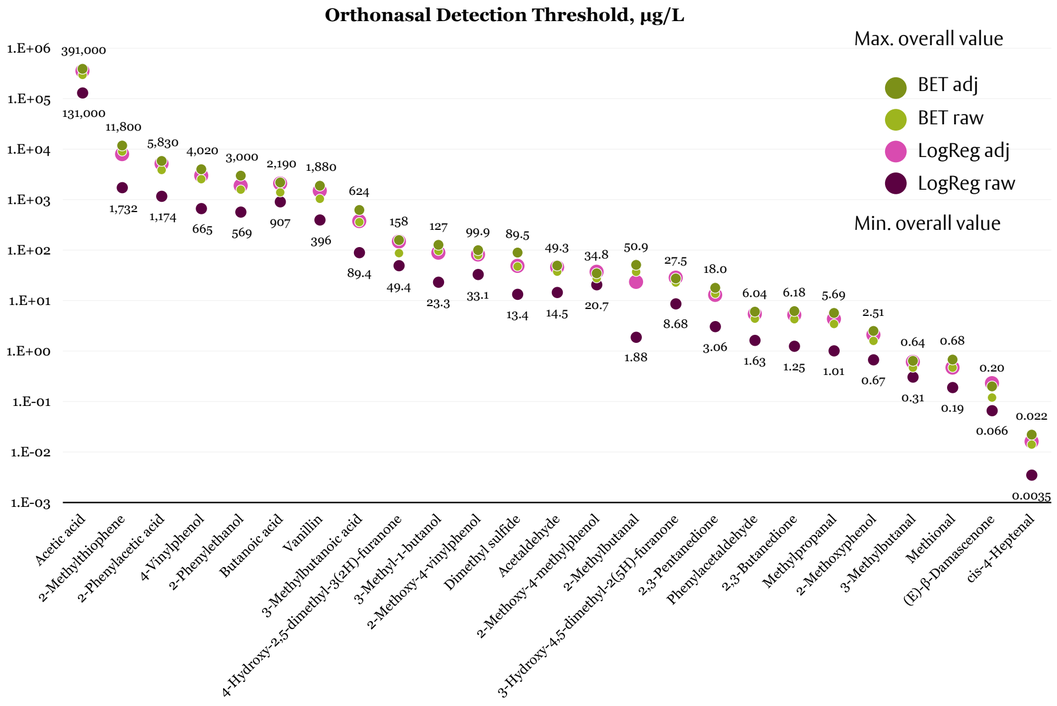


Data adjustment: Removal of False Positives

False positives are those positive responses given by chance and not related to real differences. Hough et al. (2013) reported an algorithm for the removal of these false responses by comparing them with the rest of the panel [3].

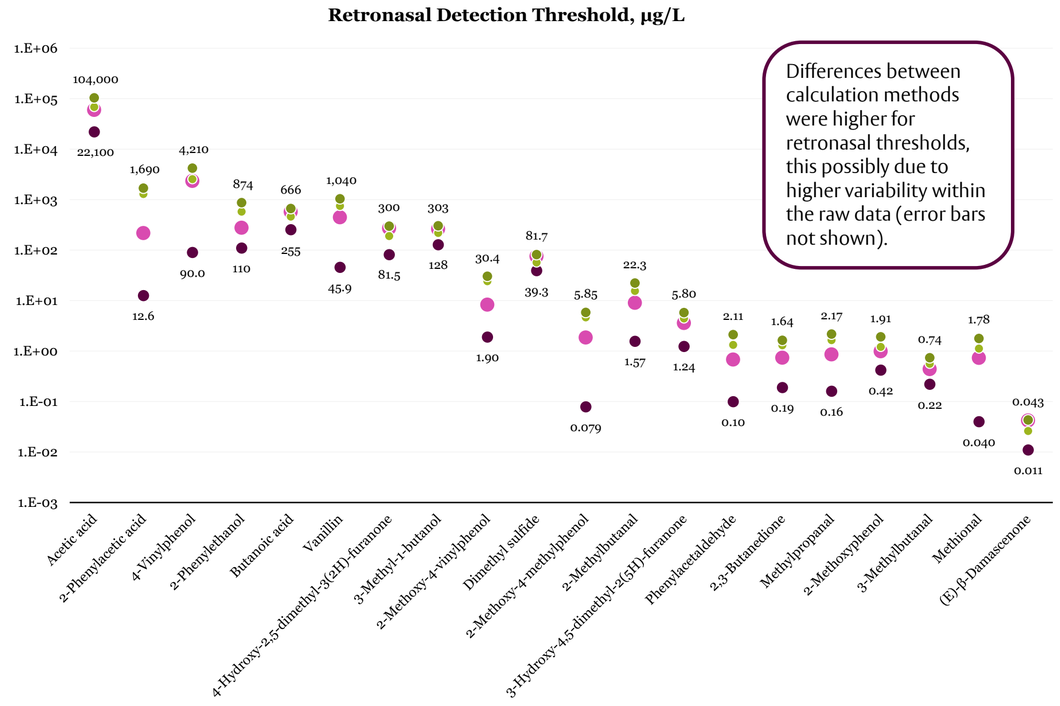
Results

Orthonasal Detection Threshold, µg/L



Both orthonasal and retronasal detection thresholds were spread along a 10^9 unit-broad range of values, from hundreds of mg/L for acetic acid to less than 0.2 µg/L for *(E)*-β-damascenone and *cis*-4-heptenal.

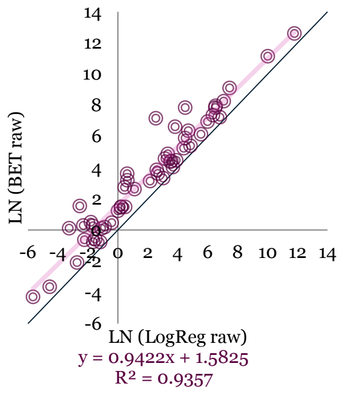
Retronasal Detection Threshold, µg/L



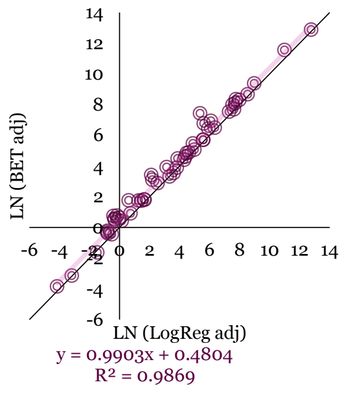
Differences between calculation methods were higher for retronasal thresholds, this possibly due to higher variability within the raw data (error bars not shown).

Comparison of calculation methods: BET vs. Logistic regression; raw vs. adjusted data

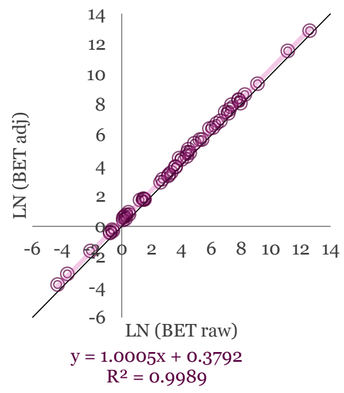
The results from each calculation method (both ortho- and retronasal) were plotted and compared using t-test for paired samples in order to find significant differences between methods.

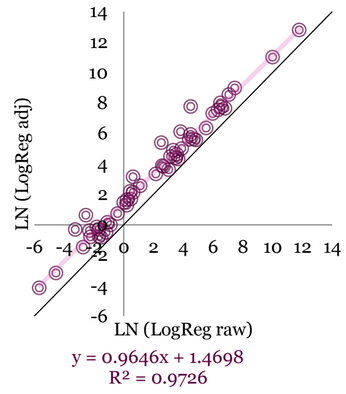


Using unadjusted data, higher threshold values were obtained from BET than Logistic regression (Intercept +1.58)



The same scenario was observed when using adjusted data, although the average difference was lower (Intercept +0.43).





For both BET and Logistic regression, the removal of false positives generated significantly higher threshold values ($p < 0.05$).

Conclusions

- Threshold values were dependent on the calculation method chosen, as well as on the treatment of the data for the removal of false positives.
- Threshold values calculated by BET were higher than those from Logistic Regression, as well as the removal of false positives also increased the final results with respect to the raw data.
- Significant differences were found between both methods (BET or Logistic regression) and data treatment (raw or adjusted data).
- The results from this study will help understand the effect of the calculation method in the final threshold and thus prevent under- or overestimating the potency of aroma compounds.

Contact information

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References

1. Perry & Hayes, *Foods*, **2016**, 5, 35
2. ISO 13301:2002
3. Hough, Methven & Lawless, *J Sens Stud*, **2013**, *28*, 414-421.

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- Icons retrieved from www.flaticon.com, authored by Freepik.