



Study of the Acceptance of Innovative Kombucha-type Beverages Coupled with Behavioral Analysis using a Connected Glass

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Study Context

On the eve of a food transition encouraging the consumption of healthy and sustainable non-dairy probiotic products, the development of fermented functional drinks based on Kombucha are considered. Studying the acceptance of these new products is therefore essential to their development.

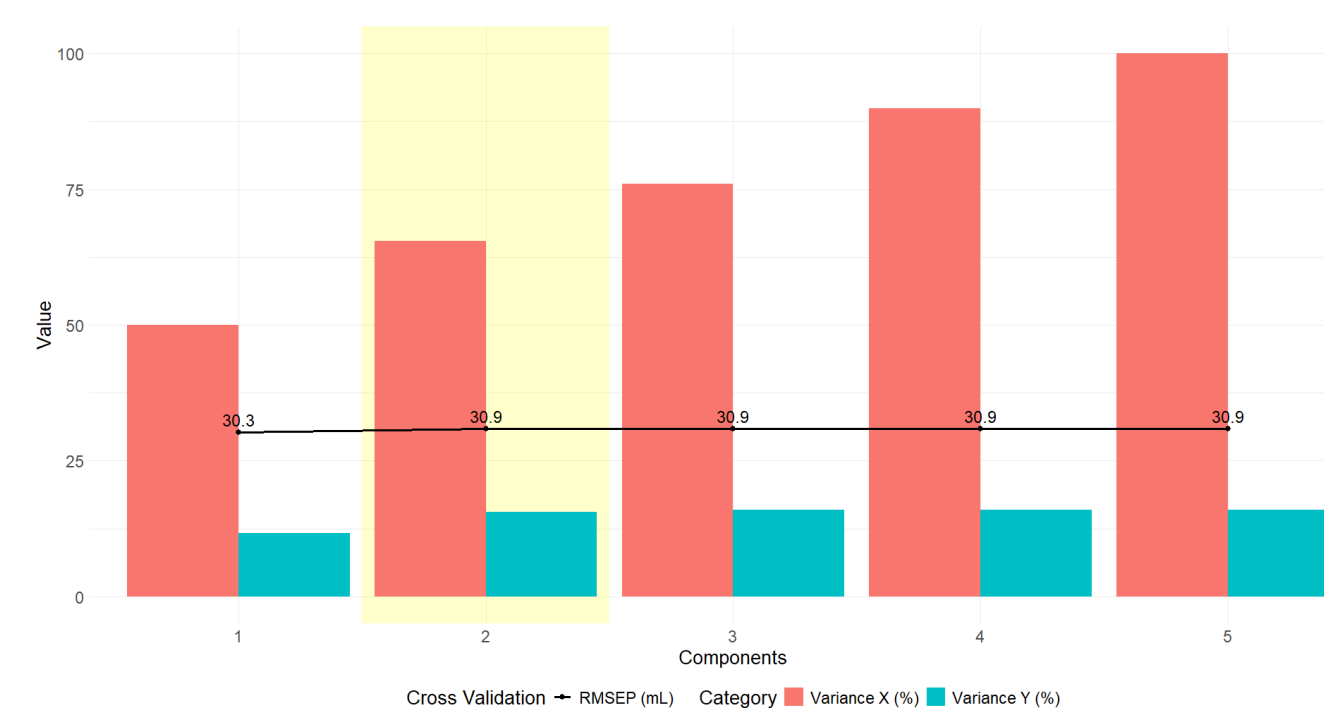
In addition, analysis of consumer behavior when it comes to tasting products provides us information linked to their assessment criteria.

In this way, connected glass technology could be used to identify behavioral profiles observed during beverage consumption, which could be linked to product appreciation descriptors as presented in the sensory analysis.



Construction of PLS regressions

For the PLS method, selecting a number of components equal to 2 minimizes the error (RMSEP) while maximizing the explained proportion of the Y variance, considering both samples. A linear regression based on the components obtained is used to determine coefficients for each descriptor.



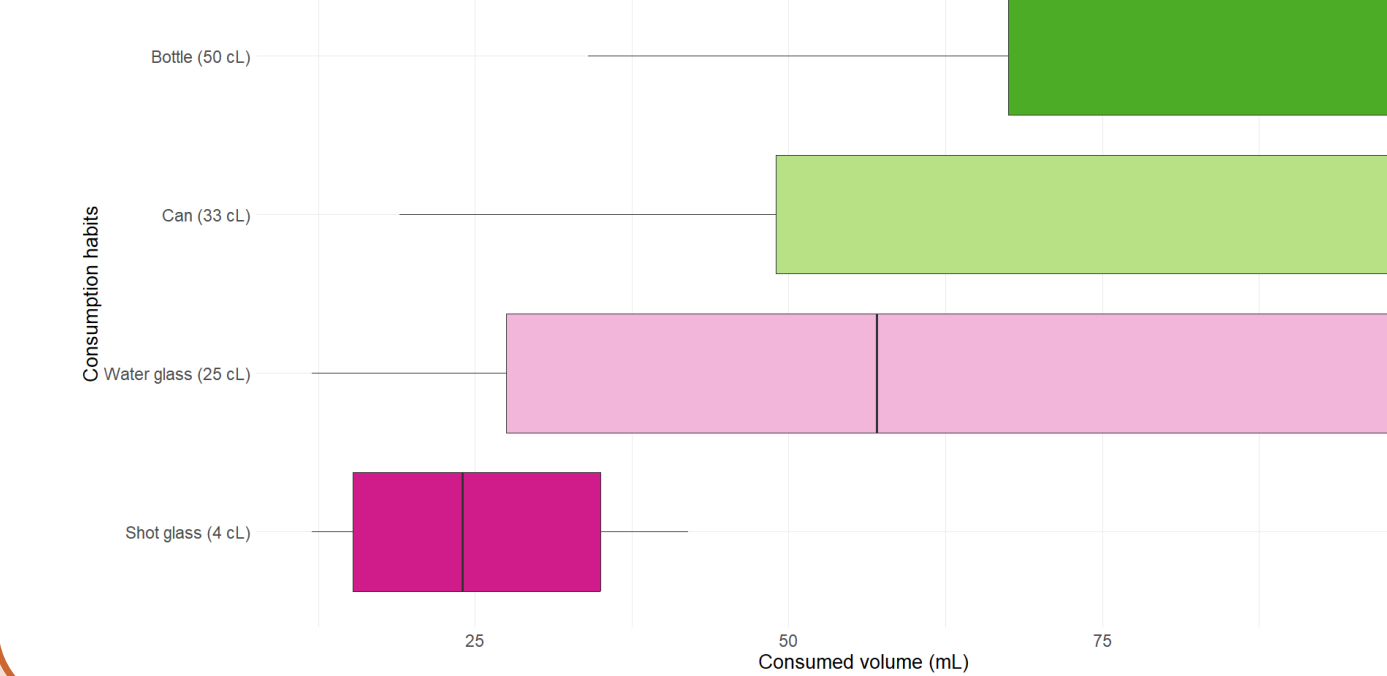
The latter characterize the influence of the various variables on the volume consumed. As the coefficients obtained were not all significant, the equations should not be considered in their entirety.

However, as the data are behavioral, the adjusted R² values obtained are satisfactory for the purposes of this study.

BIRCH INFUSION KOMBUCHA	
Consumed volume	= 21.1 + 3.9 * Acidity + 5.6 * Floral - 1.9 * Sparkling - 1.7 * Sweet + 5.5 * Overall appreciation
R ² _{adj}	= 7%
TRADITIONAL KOMBUCHA	
Consumed volume	= 31.2 - 6.2 * Acidity + 3.7 * Floral + 4.2 * Sparkling + 3.7 * Sweet + 5.8 * Overall appreciation
R ² _{adj}	= 13%

Consumer habits survey

As far as the drinking habits of the subjects surveyed are concerned, the volume consumed according to the quantity they are willing to drink is plotted.



Volume consumed therefore seems to be positively correlated with the amount of kombucha that subjects are willing to drink.

* Significant according to a Kruskal-Wallis test with post-hoc Dunn analysis.

Connected Glass Technology

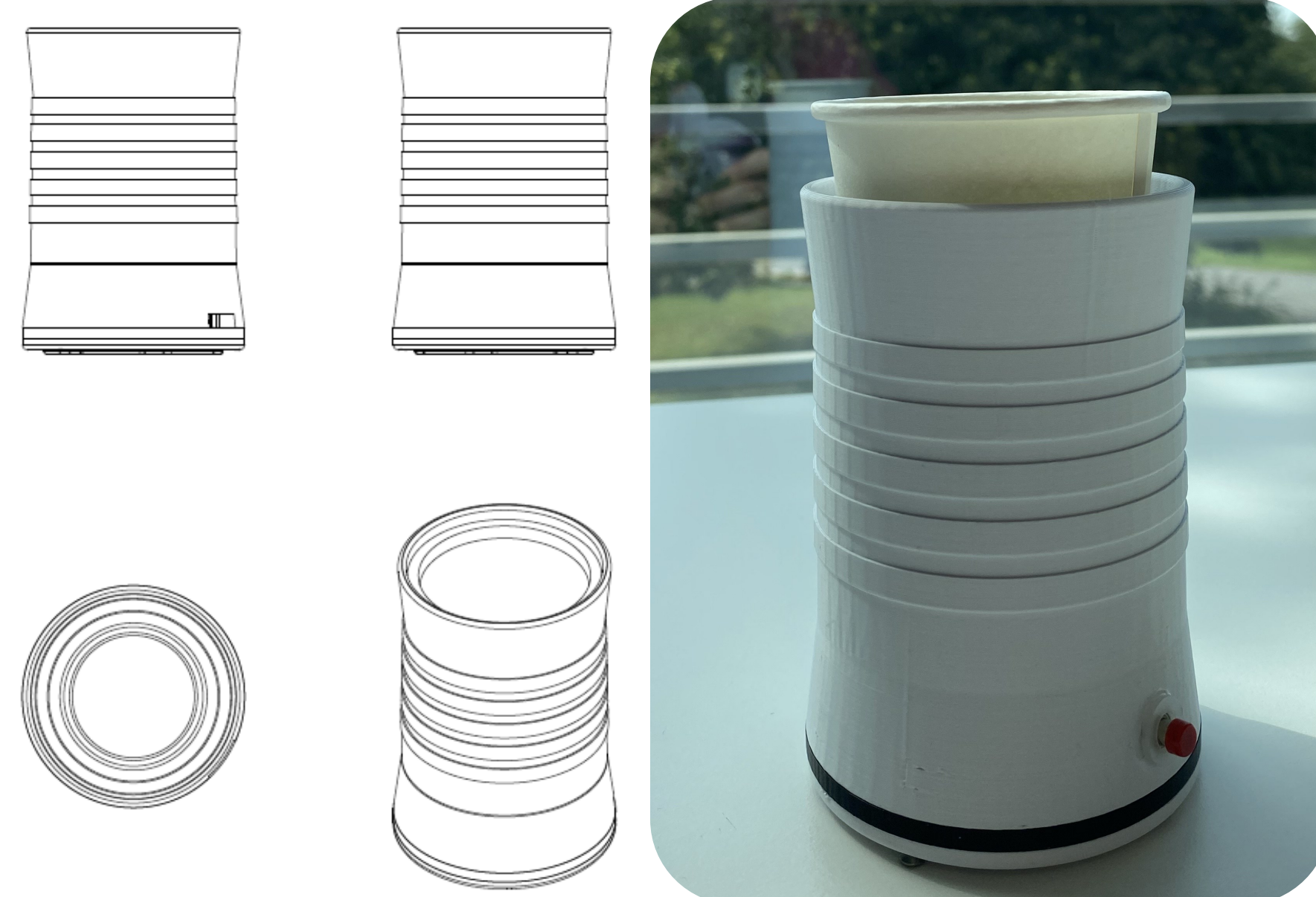
The connected glass developed as part of this study is designed as a cup holder.

It is equipped with sensors for measuring the weight of a given liquid over time.

In addition, an accelerometer measures the position of the glass in x, y, z space over time.

The raw data collected is transferred through Wi-Fi.

By means of algorithmic processing, the volume of liquid consumed and the number of theoretical sips taken by the consumer can be calculated.



Methodology

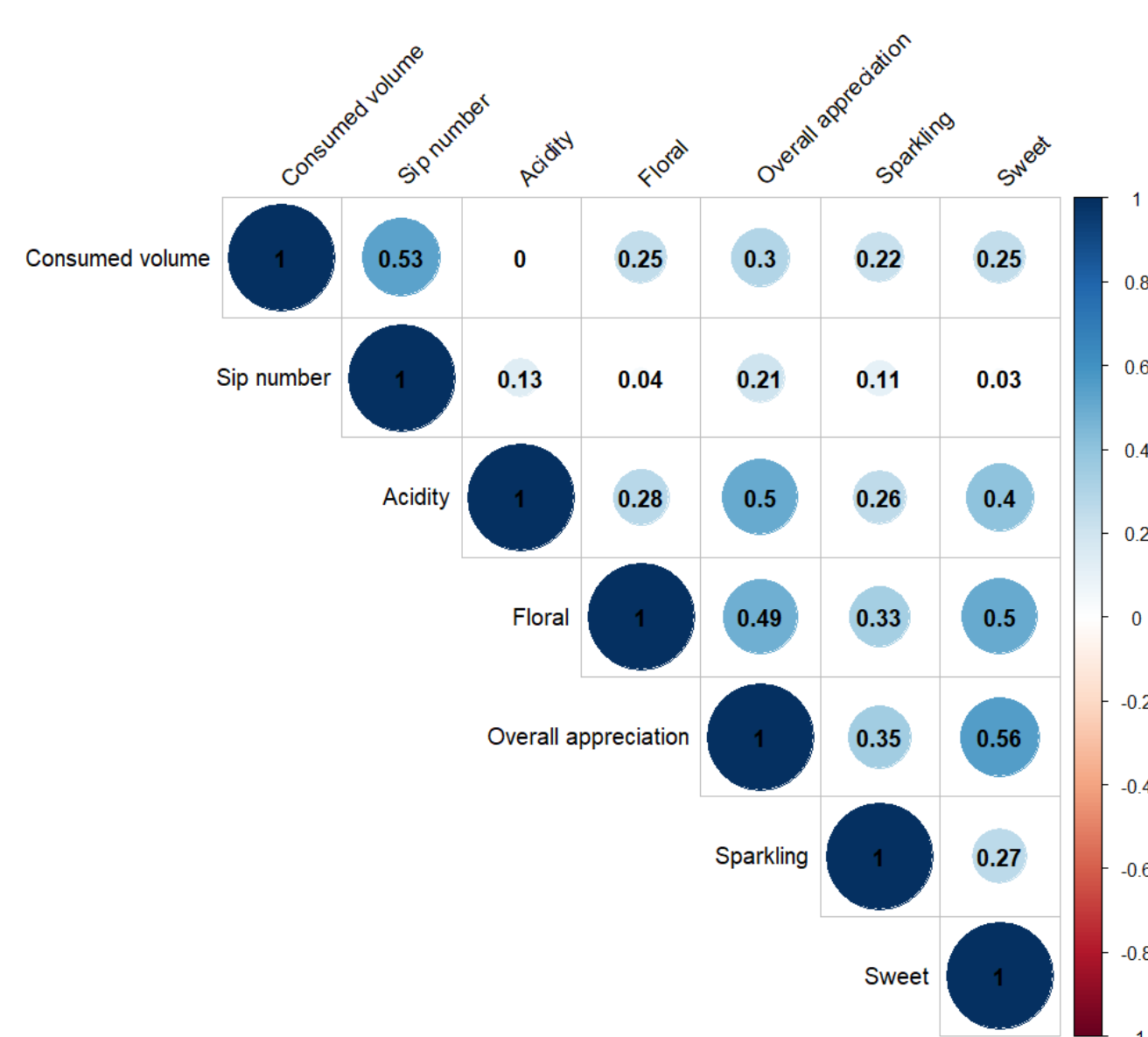
Sensory analysis is a hedonic study. Participants (n=62) in the study were untrained panelists. Two samples of refreshing kombucha beverages were presented in the connected glass: a traditional kombucha fermented from a blend of green and black teas, and a kombucha made from an infusion of birch leaves.

The survey questions included an assessment (5-point scale) of four descriptors: "acidic", "sparkling", "sweet" and "floral". A general appreciation question is also asked for each sample (5-point scale).

Samples were presented monadically and sequentially. The order of questions and samples is randomized. Two subsidiary questions concerning kombucha consumption habits are asked.

Outcomes

Investigation of data set linearity

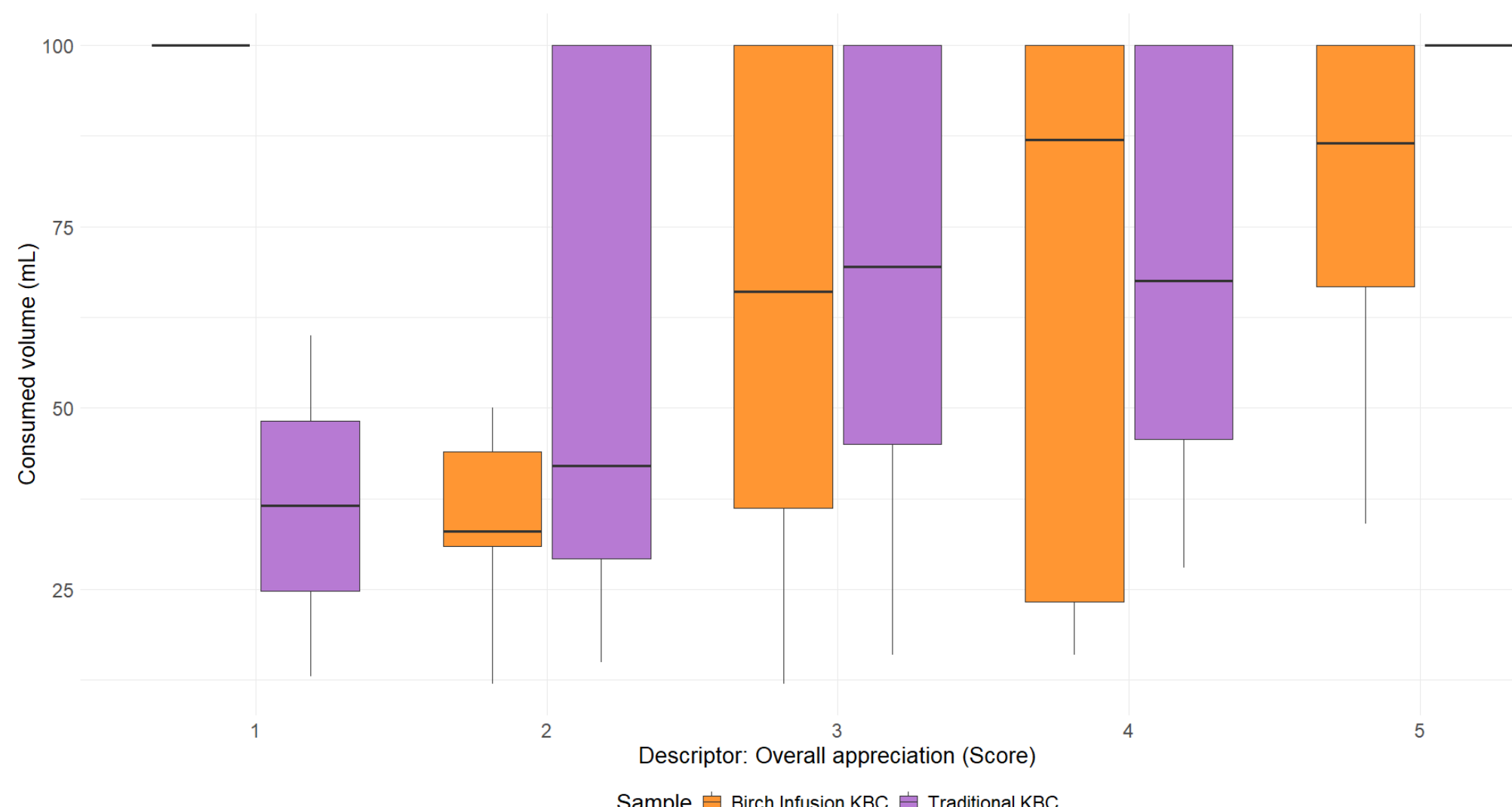


The investigation of any linear relationship between the different variables is illustrated by a correlation matrix.

The correlation matrix shown here focuses on the traditional kombucha sample, although the correlation results obtained for birch-leaf infused kombucha are similar.

The descriptor variables do not appear to be correlated with the data measured by the connected glass, i.e. the volume consumed and the number of sips.

However, since the hypothesis of co-linearity between the variables has been raised, partial least square regressions (PLS) could be envisaged.



The score attributed to the descriptor "general appreciation" based on the volume consumed for each kombucha sample is presented here.

It should be noted that the extreme scores 1 and 5 are not attributed.

Based on averages, the higher the score, the greater the volume consumed.

Prospects

This preliminary study reflects the complexity of coupling the data obtained during sensory analysis with the ones from the connected glass used. A number of potential applications have emerged from this work.

The prior hypothesis suggests that the consumption behavior is significantly influenced by the sensory analysis protocol (e.g., initial volume, number of questions, number of products).

In this way, the investigation of the consumption behavior by collecting data such as the time spent drinking, the gap between sips, and the volume of each sip could be considered. Additionally, an algorithm could be developed to measure the number of sequential sips taken over time.

Moreover, other sensory analysis methods could be proposed, such as descriptive and discriminative tests. The various kombucha samples could be presented simultaneously or alongside a reference sample to encourage comparison.

Future plans include recruiting a trained panel but also increasing the consumer sample size for advanced statistical analysis to assess the statistical relevance of the various variables.

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