The Sensory Quality of Fresh Bread: Consumers' Perceptions, Descriptive Attributes, and Volatile Composition

Samuel Heenan[1], Jean-Pierre Dufour[1] Winna Harvey[2], Conor Delahunty[1]
[1]Sensory Science Research Centre, Department of Food Science, University of Otago, Dunedin, New Zealand
[2]New Zealand Institute for Crop and Food Research Limited, Christchurch, New Zealand

Introduction

The perceived freshness of the sensory qualities of breads is one of the key determinants of bread acceptance. Consumers have a definite appreciation of what constitutes freshness, based upon their individual experiences involving complicated physiological and psychological processes. This perception is not easily described, particularly as it is likely to vary from one bread type to another. By linking descriptive sensory analysis and a rapid sensitive instrumental technique such as Proton Transfer Reaction Mass Spectroscopy (PTR-MS) with consumer freshness judgments, an objective interpretation could be used to explain the freshness perception perceived by consumers.

Objective

- To relate consumer freshness judgments of different bread types to descriptive sensory analysis and volatile composition so an objective understanding of the freshness perception can be determined.

Methods

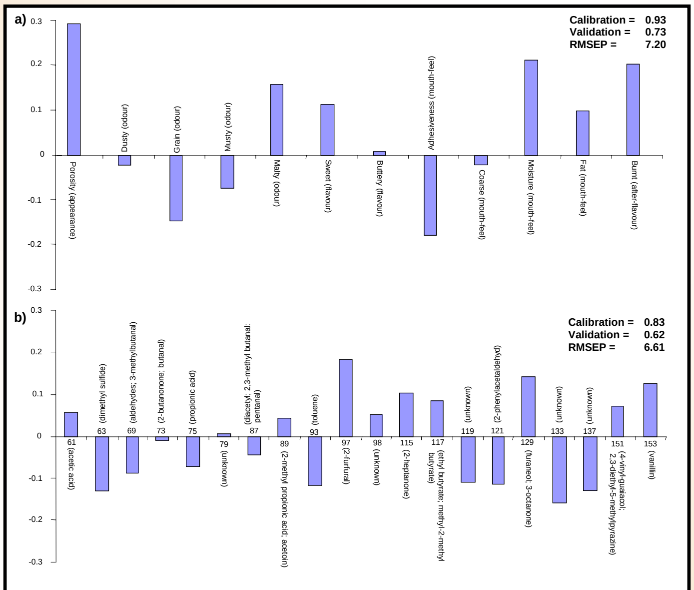
- Bread samples were selected from local commercial bakeries (n=10) and national supermarket brands (n=9).
- Regular bread consumers (n=115) balanced by age and gender rated locally baked bread (n=10) freshness on a 150 mm labeled magnitude scale (LMS). Breads were assessed by appearance, smell, taste, and were then consumed. A context was read to evoke a more affective response.
- A trained sensory panel (n=10) carried out descriptive analysis on all breads (n=19) using a defined vocabulary of 27 attributes. Attribute intensities were rated on unstructured 100 mm line scales.
- Headspace volatile composition of all samples (n=19) was conducted by PTR-MS. Data was collected over a mass range of m/z 20 to 180. Mass ion intensities were measured in ppb.
- With data from the 10 breads assessed by consumers, Partial Least Squares Regression (PLSR1) was applied to create three different models relating sensory attributes to consumer freshness [Model 1], volatile composition to consumer freshness [Model 2] and simultaneously sensory attributes and volatile composition to consumer freshness [Model 3].
- Attributes and mass ion variables that contributed little information were removed from the models. Optimum models were selected based on root mean square error of prediction (RMSEP), which showed average uncertainty expected when predicting consumer freshness. These models were used to predict freshness of the 9 additional supermarket breads.

Result & Discussion

- Consumers significantly (F=12.717, $p<0.05$) discriminated differences between bread types (n=10) selected from local bakeries based on freshness.
- Plots of consumers by bread type showed that all consumers perceived freshness similarly.
- Twelve sensory attributes [Model 1] and twenty mass compounds [Model 2] were correlated with consumer freshness. Calibration, validation and RMSEP for both sensory and volatile composition data indicated models all had good predictive power (Figure 1).
- Fresh bread could be described as having a porous (aerated) appearance, malty, buttery odour, moist, fat (oily) texture with a burnt (toasted) aftertaste, whilst least fresh bread was depicted as having dusty, musty and grain odour with an adhesive coarse texture (Figure 1a).
- PTR-MS analysis distinguished bread differences by their volatile composition and enabled correlations of specific mass ions associated with bread freshness. Fresh bread was associated with mass ions likely attributed to acetic acid, 2-methyl propionic acid, acetoin, 2-furfural, 2-heptanone, ethyl butyrate, methyl-2-methyl butyrate, furaneol, 3-octanone, 4-vinyl-guaiacol, 2,3-diethyl-5-methylpyrazine and vanillin (Figure 1b).

Conclusion

Relating consumer freshness judgments to sensory descriptive analysis and volatile composition enabled an objective understanding of bread freshness. This approach clearly showed specific sensory characteristics and volatile compounds that were associated with the freshest breads, and by doing so enabled a new and powerful interpretation of bread freshness perception.

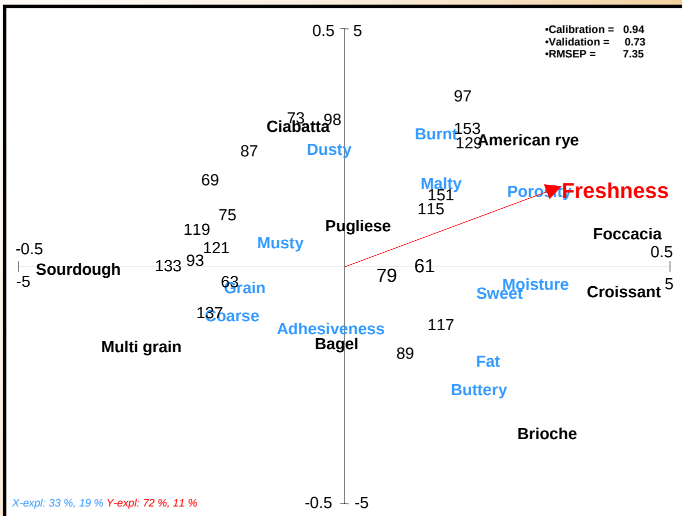


Bread samples

Freshness	Sourdough	Pugliese	Foccacia	Ciabatta	Rye	White	Bagel	Brioche	Multigrain	Croissant	1	2	3	4	5	6	7	8	9
Measured consumer	37.1	55.8	69.1	54.2	65.2	53.9	50.9	55.0	38.0	67.6	NA	NA	NA	NA	NA	NA	NA	NA	NA
Predicted sensory [Model 1]	47.4	55.9	68.3	50.2	65.0	53.4	49.6	52.8	35.7	68.5	51.3	40.9	37.9	48.0	33.3	46.5	31.3	42.9	51.1
Predicted volatile [Model 2]	35.1	53.1	68.8	57.9	63.5	51.8	49.2	58.4	42.4	66.7	53.8	54.4	60.9	51.3	59.5	52.3	42.5	39.8	58.1

Figure 1:PLS1 analysis, indicates positive and negative loadings between sensory attributes (a) and volatile compounds (b) associated with consumer freshness rating . Calibration, validation coefficient and root mean square error of prediction (RMSEP) are shown. Bread freshness results measured by consumer sensory analysis and predicted using descriptive sensory analysis and volatile composition for additional breads are illustrated.

- By simultaneously relating sample volatile composition and sensory character (X-variables) to consumer freshness (Y-variables) [Model 3] a biplot could be created to visually represent relative differences between bread freshness. Freshest breads were foccacia, American rye, croissant and brioche. Sensory attributes and volatile compounds associated with freshness can be observed (Figure 2)
- Predicted freshness appeared valid for 6 of the 9 supermarket breads when comparing sensory [Model 1], volatile [Model 2] and simultaneously sensory and volatile [Model 3] (Figure 1 & 2). Supermarket breads 3, 5, and 7 displayed a high level of variation in predicted freshness, which may be the result of differences in sensory character or volatile composition unaccounted for in the original 10 breads evaluated by consumers.



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Predicted [Model 3]	36.9	55.0	69.0`	54.6	65.5	54.3	51.3	55.1	38.0	67.5	50.7	51.7	54.4	50.2	50.3	50.6	37.3	37.2	55.9

Figure 2. PLS1 analysis showing a biplot of the correlations between sensory data, compound mass concentration and consumer freshness for 10 breads. Shown are predicted versus measure freshness using the PLS model with calibration, validation coefficients and RMSEP.

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