

Exploration of time-resolved sensory effects of designed salt mixtures in culinary food applications

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1. Introduction

Temporal Dominant Sensations (TDS) - a data acquisition method for time resolved sensory profiling - was applied on designed salt mixtures dissolved in water.

The salt mixtures were generated according to a mixture design capable of estimating the sensory effects of the single ingredients (i.e. bakers yeast, KCl, NaCl, NH₄Cl) and their first-order interactions.

The purpose of this work was to explore how yeast extracts can be used in sodium salt reduction strategies to modulate the temporal sensory effects evoked by the replacements salts

The TDS-data were modeled and visualized by means of generalized linear models with Poisson and Binomial link functions and additional penalties to correct for deviations to prior knowledge (i.e. smoothness, monotonicity).

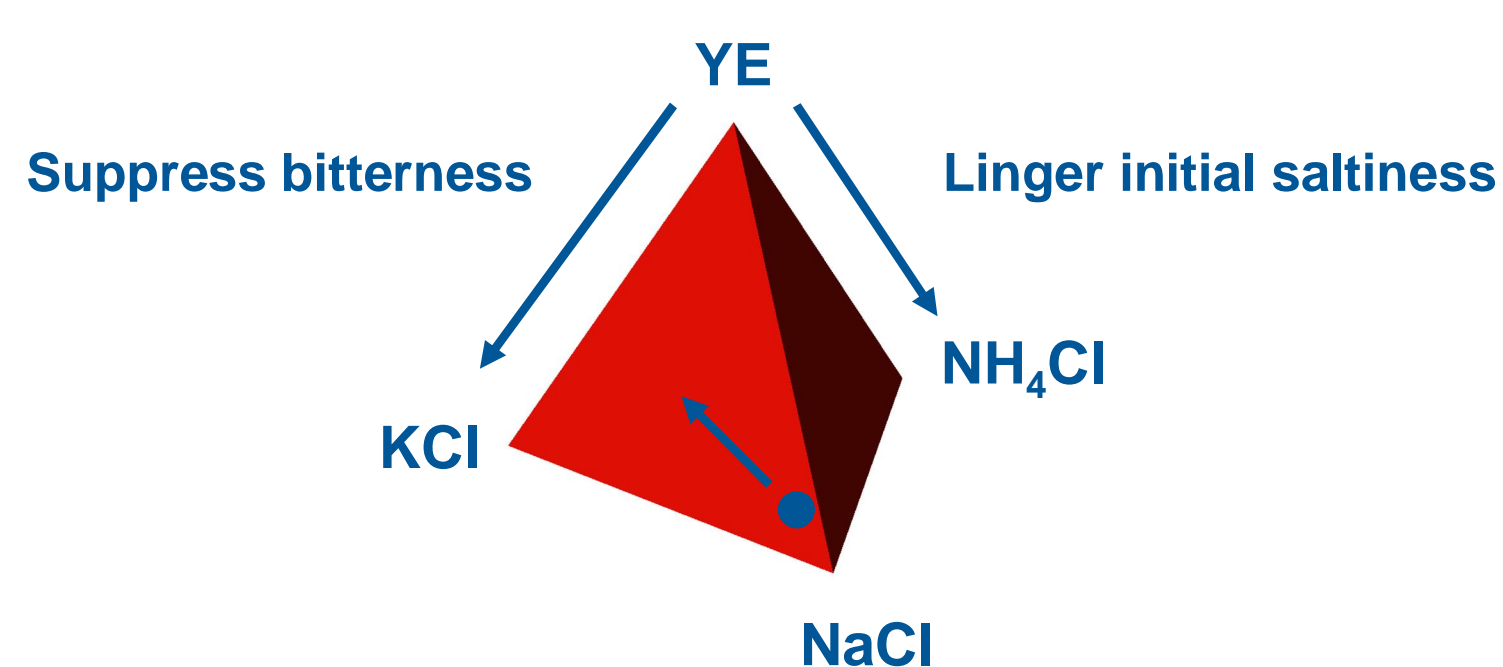
This poster reports the work in-progress and the first results of the extreme points in the experimental design are discussed.

2. Mixture designs

Sodium, potassium and ammonium salt were formulated together with a yeast extract according to a four factor mixture design capable of estimating the sensory effects (expressed as sensogram parameters (like area-under curve, t-max, etc.) of the single ingredients (corners of the tetrahedron) and first order interactions.

Examples of interactions of interest are

- YE-KCl : suppression of bitterness
- NaCl - KCl : suppression of bitterness
- YE-NH₄Cl : lingering of saltiness
- NH₄Cl - NaCl : spiking initial saltiness
- YE - NaCl : maintaining fullness



3. TDS

Temporal Dominant Sensations (TDS) is an easy-to-use sensory data acquisition tool that allows untrained panelists to record the most dominant temporal sensory sensation (obtained from a pick list) as a function of time [1,2].

The collected data are commonly represented as a time x attributes contingency table with counts for each panelist/replicate and visualized by complex curve fitting models. Unfortunately, these models completely ignore the binary nature of the data, eagerly over-fit and result in meaningless curvature..

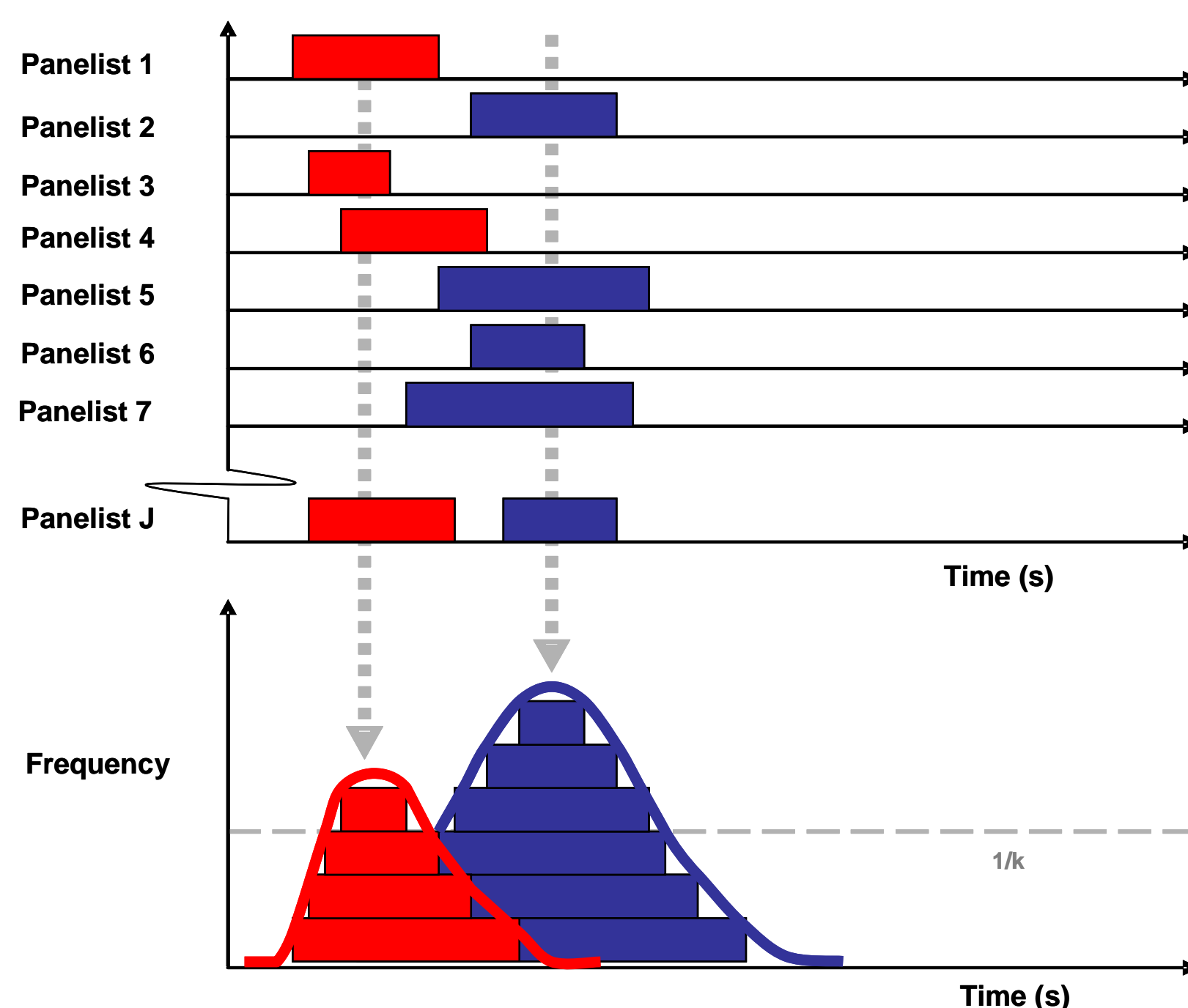


Figure 1. Conceptual representation of TDS profiling.

4. TDS Sensograms

The TDS-experiments were conducted in quadruplicate with a trained professional sensory panel (N=14) using commercial sensory data-acquisition software (Fizz). Dynamic sensory profiles (sensograms) were constructed by Penalized Poisson regression models adding means to control smoothness and monotonicity of the sensograms, based on available prior knowledge. Examples of sensograms for some of the design points are shown below.

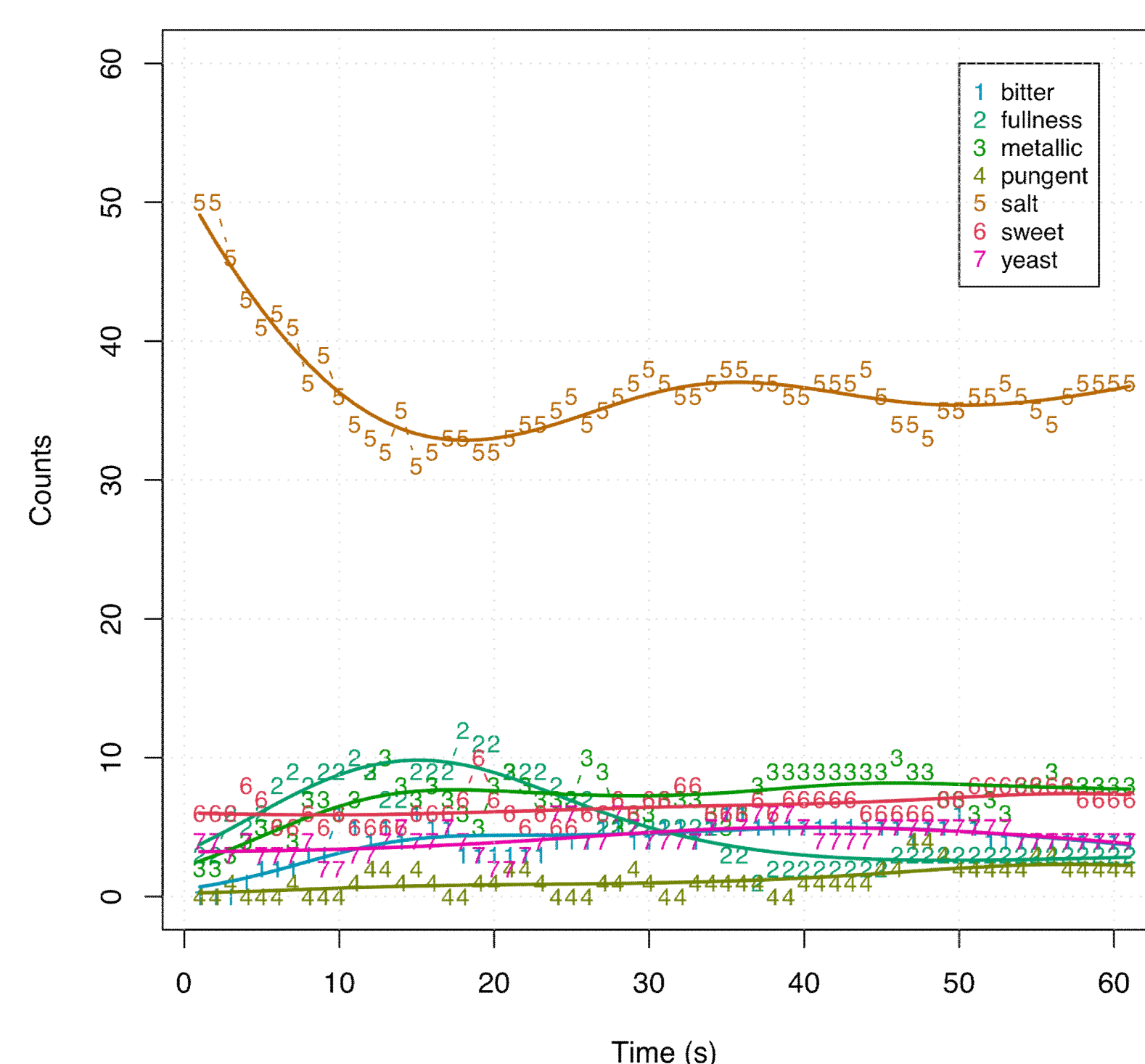


Figure 2. TDS sensogram of the NaCl solution showing initial and lingering saltiness.

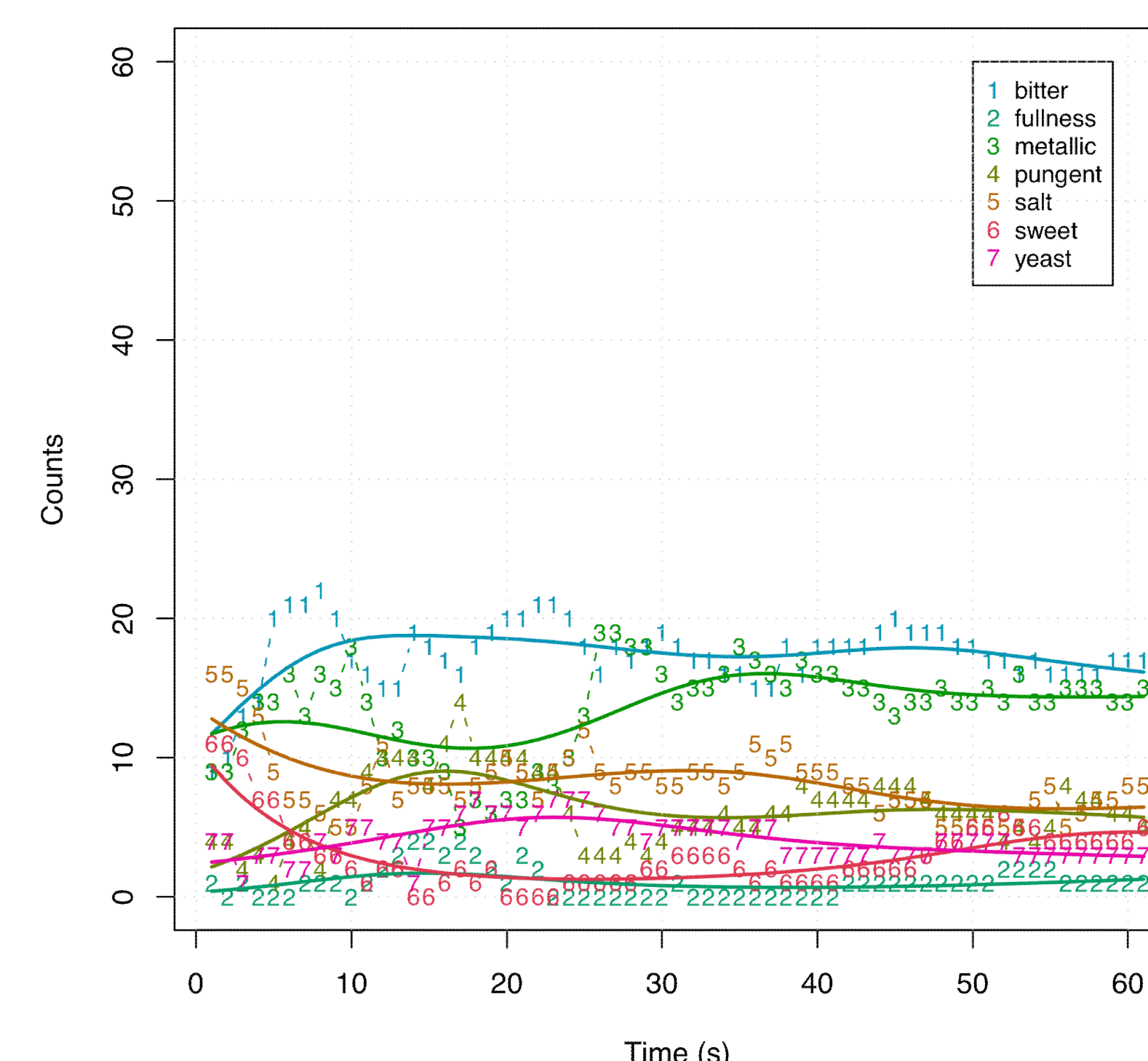


Figure 3. TDS sensogram of the KCl solution showing bitterness as dominant attribute and metallic aftertaste.

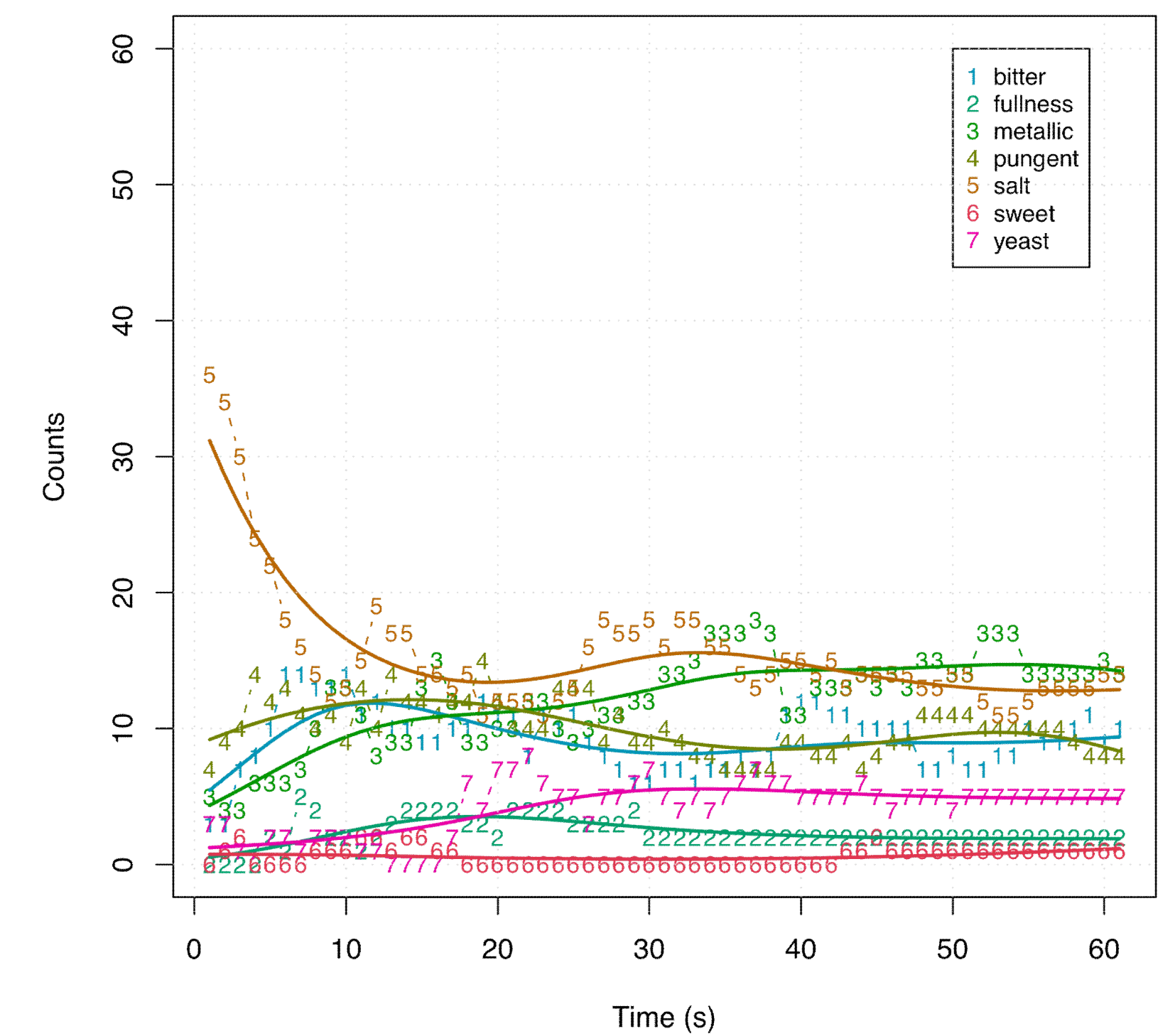


Figure 4. TDS sensogram of the NH₄Cl solution showing initial and lingering saltiness.

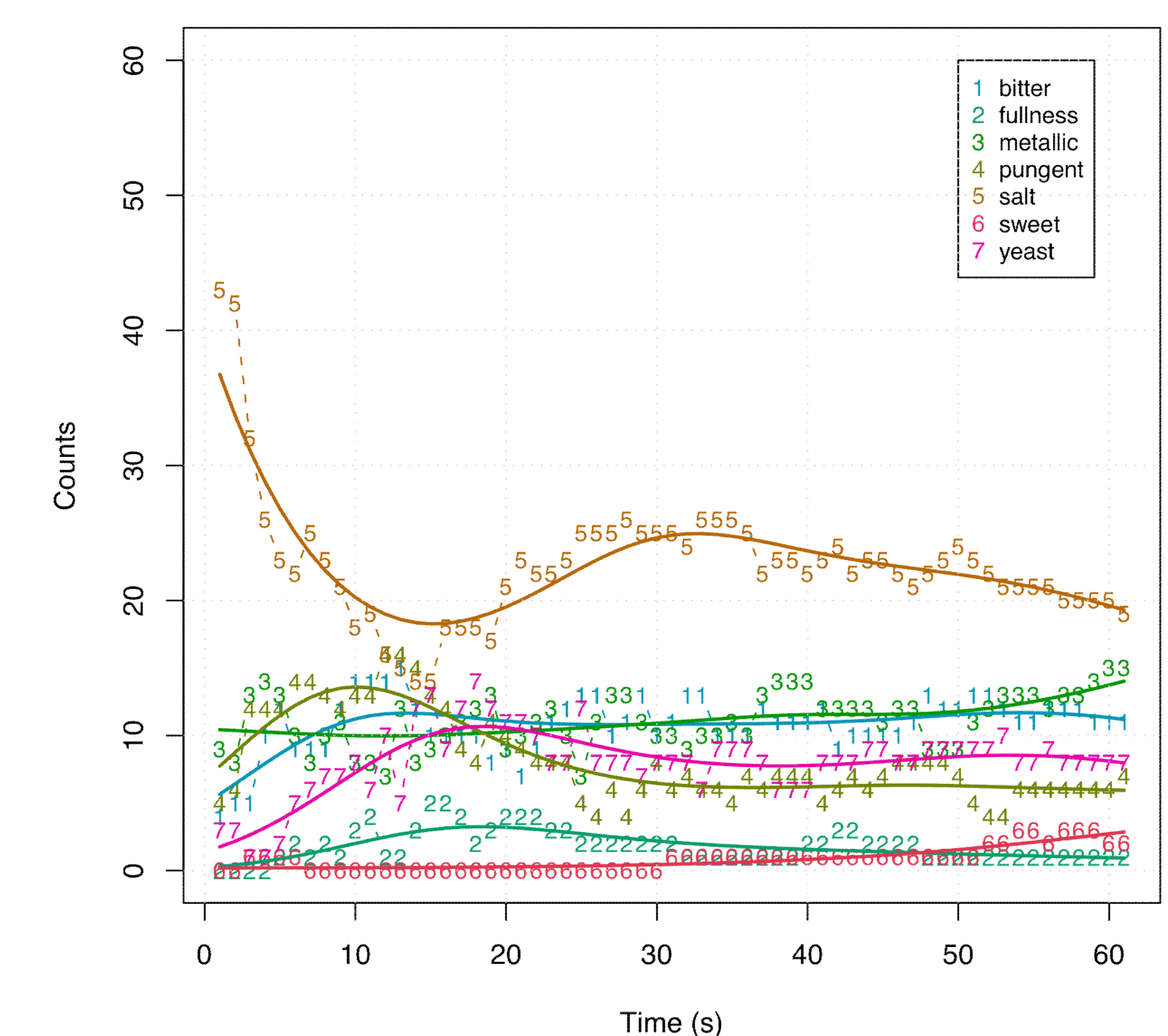


Figure 5. TDS sensogram of the NH₄Cl solution enriched with a yeast extract showing initial and lingering saltiness.

5. Discussion

The sodium chloride formulation (Figure 2.) evoked high initial and lingering *saltiness* and fullness during the first 30 seconds. The potassium chloride formulation (Figure 3.) dominated on *bitter* and *metallic* without a clear contribution to saltiness. The ammonium chloride formulation showed high initial *saltiness* and increasing *metallic* (after)taste. Both initial *saltiness* and salty lingering were enhanced by adding a bakers yeast extract (Figure 5.)

Future work will focus to formulae optimization based on AUC-ratio's (i.e. maximize $AUC(salt) / AUC(metallic+bitter)$)

6. References

1. Pineau, N., Schlich, P., Cordelle, S., Mathonniere, C., Issanchou, S., Imbert, A., Rogeaux, M., Etiévant, P., Köster, E. (2009). *Temporal Dominance of Sensations Construction of the TDS curves and comparison with time-intensity*. Food Quality and Preference, 20(6), 450-455.
2. Labbe, D., Schlich, P., Pineau, N., Gilbert, F., & Martin, N. (2009). *Temporal dominance of sensations and sensory profiling: A comparative study*. Food Quality and Preference, 20(3), 216-221.