Determination of equivalence between intensity scales by means of paired comparison

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Sensory profiling results are often presented as bar graphs or spider plots showing panel mean intensities for a number of descriptors, i.e. defined sensory qualities. The relative information regarding the descriptors presupposes equality of the scales used to measure each descriptor. Various attempts have been made to create universal scales or to enforce a scale usage that will allow direct comparison among different descriptor scales. In practice, the scale equality is more often assumed than proven. This paper demonstrates a method for checking scale equality by juxtaposing indirect and direct comparisons of intensity.

Sweetness and sourness were measured by a professional panel (N = 31) for aqueous solutions of sucrose and lactic acid, respectively, using the audio method of intensity profiling. Regions of postulated equivalent sensory intensity (equal Hz values on these scales based on a confidence level of 95%) were obtained by examining the two dose response curves, i.e. the intensity as a function of log concentration. The procedure used involved a prediction of intensity scores and their standard deviations for specific concentrations of each substance: $\hat{x}$, $\hat{y}$ and s_x, x_y with df_x and df_y degrees of freedom. The expected value of the difference in scores is $\hat{x} - \hat{y}$, assuming the standard deviations of the two means are independent. The standard deviation of the difference is approximated by $(df_x s_x + df_y s_y)/(df_x + df_y)$ with $df_x + df_y$ degrees of freedom.

The same panel carried out direct comparisons of sweetness and sourness by means of 2-alternative forced choice (2-AFC) tests in which the sample with the higher intensity was chosen. Generalized linear models were used to determine prediction intervals at 95% confidence level based on the proportion of wins, i.e., more intense samples. A model with logit link was used to determine the dependence of wins on the log concentration of either sucrose or lactic acid.

When fourth-order models were used to show the concentration dependence of sweetness and sourness obtained from either profiling or 2-AFC data, the equivalence regions could be visualized in detail. Superimposing the direct (2-AFC) and indirect (profiling) comparisons revealed the same equivalence regions for both methods, thereby justifying the assumption that the audio method produces equivalent sweetness and sourness scales.