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DUAL-ATTRIBUTE TIME-INTENSITY SENSORY EVALUATION: A NEW METHOD FOR TEMPORAL MEASUREMENT OF SENSORY PERCEPTIONS

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ABSTRACT

Dual-attribute time-intensity was evaluated as a method for the collection of the perception of two attributes simultaneously. Perceptions of sweetness and peppermint flavour within chewing gum were measured by 10 trained time-intensity panelists using both single-attribute and dual-attribute time-intensity sensory evaluation. Four chewing gum samples, varying in rate of release of sweetness and peppermint flavour were presented for evaluation. In general, dual-attribute time-intensity was as sensitive as single-attribute testing in distinguishing between the sweetness and peppermint perceptions of chewing gum. In comparison to the single-attribute test, the dual-attribute test required half the time to complete and provided a means of assessing complex taste interaction during mastication. The dual-attribute test can be used to study relationships between two attributes within food products which possess a large degree of sample variability, such as the tenderness and juiciness of meat. © *1997 Elsevier Science Ltd*

Keywords: Dual-attribute time-intensity; chewing gum; sweetness; peppermint.

INTRODUCTION

Foods possess a composite of many attributes of taste. One of the simplest of these mixtures occurs in chewing gum which is comprised of two tastes; sweetness and flavour. Evaluations of perceptions of these two tastes are typically made for individual attributes. The interactions between these attributes have not been measured simultaneously. Time-intensity sensory evaluation has been used to evaluate single-attribute perceptions. The method elucidates the temporal characteristics of taste perceptions. The research reported in this paper demonstrates how time-intensity can be used for the simultaneous evaluation of two attributes within a food. This technique allows food scientists to directly explore taste interactions as they occur over time.

Although time-intensity is an important advancement in the evaluation of single attributes, it has not been applied to the simultaneous evaluation of two or more attributes. Knowledge of the interactions of taste attributes has positive implications for the development of new food products. After evaluating the taste interactions within a food, the characteristics can be optimized to provide the most acceptable product to the consumer. Therefore, it would be of benefit to product developers to know the combined perceptions of sensory attributes within a food. With the relative ease of collecting time-intensity data using computer programs, it has become possible to modify the time-intensity program for such a purpose.

To allow for the simultaneous evaluation of two food attributes, the current version of the Computerized Sensory Analysis Temporal Profile Analysis package (CSA_{TPA}^{TM}) from Compusense Inc. was modified. The dual-attribute time-intensity method (DATI) is similar to the single-attribute test with the exception that two time-intensity scales, each representing one taste attribute, appear on the monitor. One taste is presented on the horizontal time-intensity scale, and the other taste is presented on the vertical time-intensity scale. Previous research has shown that horizontal and vertical line orientations can provide similar time-intensity results (Duizer *et al.*, 1994). A mouse is used to move a cursor simultaneously along the two time-intensity lines. Panelists in dual-attribute time-intensity evaluations are trained to direct the movement of the mouse in two directions simultaneously to record the changes in their perceptions of the two attributes.

To investigate dual-attribute time-intensity, four samples of chewing gum, which varied in rates of release of sweet and peppermint flavour, were tested. The manipulation of temporal changes in sweetness and peppermint

TABLE 2. Probability Scores for Each of the Eight Time-Intensity Parameters and T-IR by Taste, Attribute and Taste×Attribute

	Taste[1]	Attribute[2]	T*A
AUC	0.004	n.s.	n.s.
DEC ANGLE	n.s.[3]	n.s.	n.s.
DEC AREA	0.014	n.s.	n.s.
DUR	n.s.	n.s.	n.s.
IMAX	0.001	n.s.	n.s.
INC ANGLE	0.046	n.s.	0.035
INC AREA	0.038	n.s.	n.s.
TMAX	n.s.	n.s.	n.s.
T-IR	n.s.	n.s.	n.s.

[1]Taste = sweet or peppermint.
[2]Attribute = single-attribute or dual-attribute time-intensity test.
[3]n.s. = $p > 0.05$.

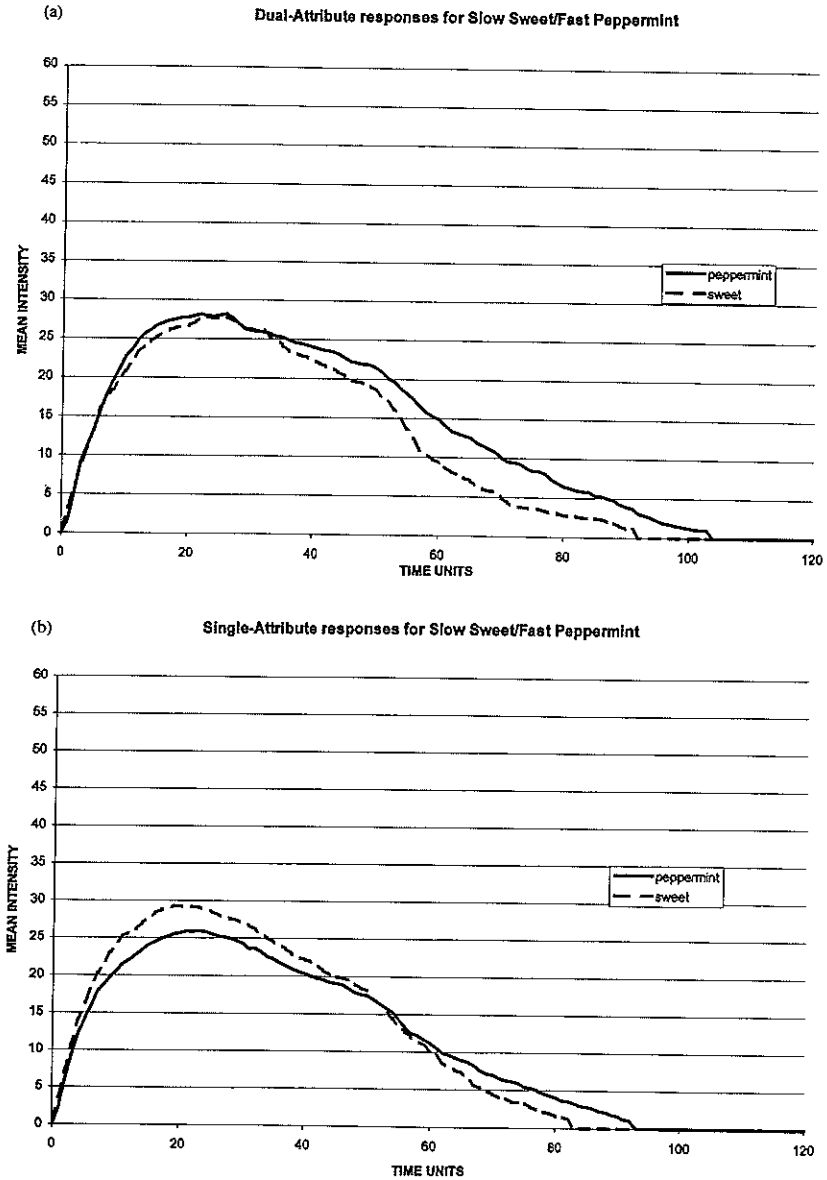

FIG. 2. Average time-intensity curves for slow sweet/fast flavour (SSFF) chewing gum as measured by (a) dual-attribute time-intensity. (b) single-attribute time-intensity.

Sweetness vs peppermint perception

Under both single and dual-attribute methods, perceptions of sweetness and peppermint tastes differed for four time-intensity parameters: IMAX ($F(1,8) = 23.88$, $p = 0.001$), AUC ($F(1,8) = 16.18$, $p = 0.004$), DEC AREA ($F(1,8) = 9.89$, $p = 0.014$), and the INC ANGLE ($F(1,8) = 5.57$, $p = 0.046$) (Table 2). In all four cases, perceptions of sweetness were greater than perceptions of peppermint. Differences in the area under the increasing angle (INC AREA) for sweetness and peppermint ($F(1,8) = 6.16, p = 0.038$) occurred only during dual-attribute testing. Sweetness and peppermint time-intensity curves averaged across all panelists are illustrated in Figs 2, 3, 4 and 5. Each figure shows the time-intensity curve for sweetness and the time-intensity curve for peppermint for the appropriate sample.

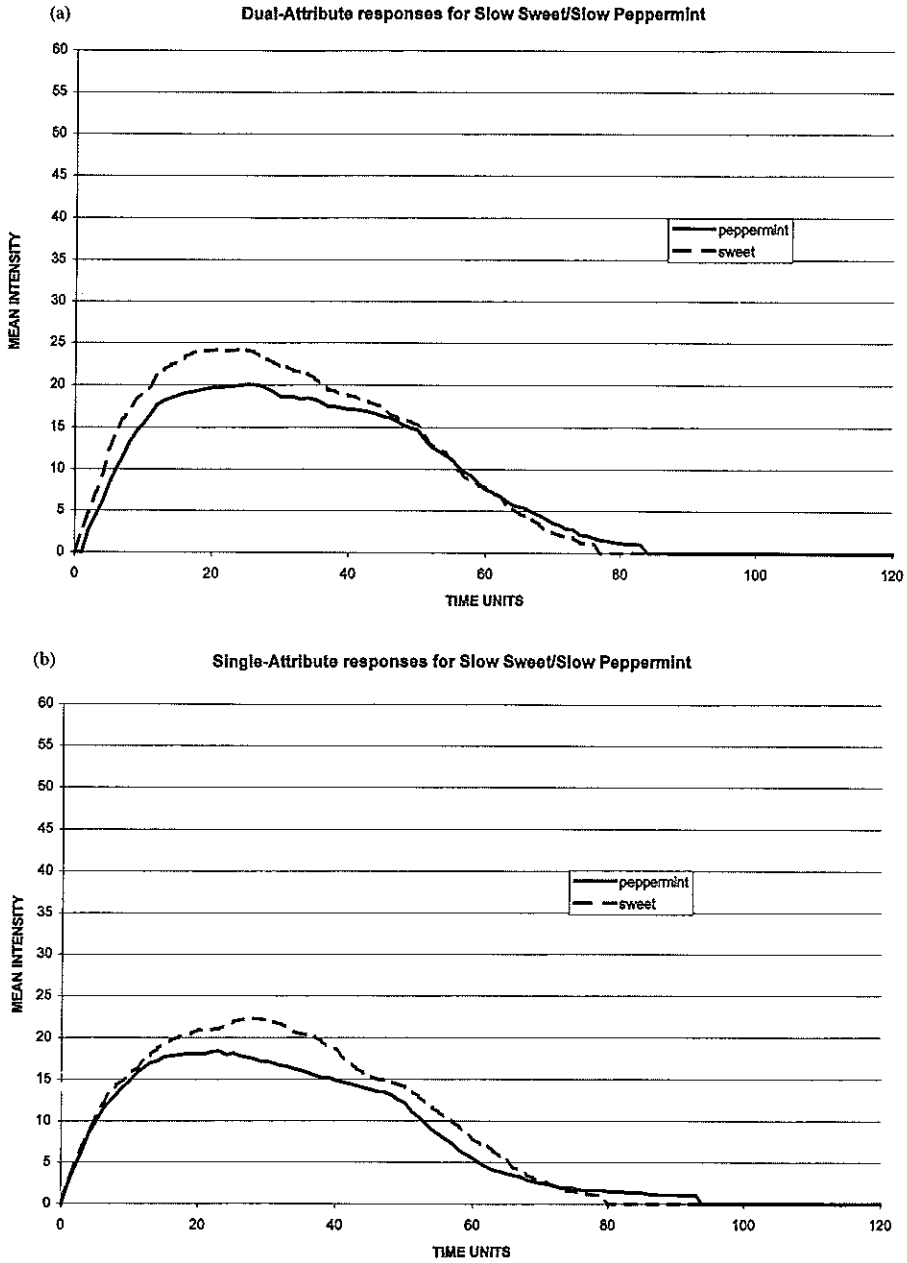

FIG. 3. Average time-intensity curves for slow sweet/slow flavour (SSSF) chewing gum as measured by (a) dual-attribute time-intensity. (b) single-attribute time-intensity.

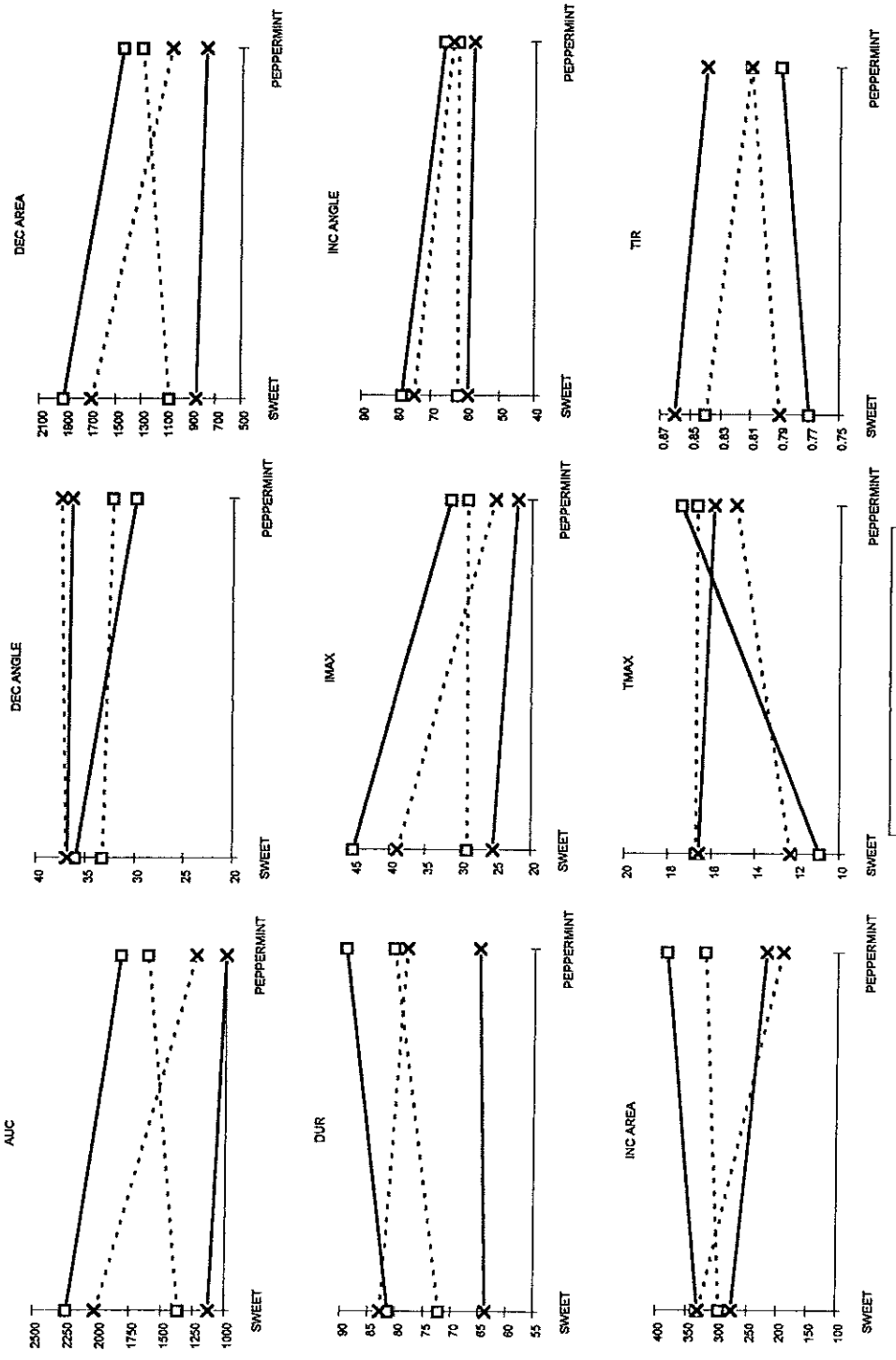

FIG. 6. Means of eight time-intensity parameters and T-IR extracted from dual-attribute time-intensity curves for four chewing gum samples.

The time required to collect data by dual-attribute time-intensity is one half that required to collect the same information by single-attribute time-intensity. For this research, 12 days of testing were necessary to collect information about sweet and peppermint flavours of four chewing gums in three replications by single-attribute time-intensity sensory evaluations, while only six days of testing were required to collect the same information by dual-attribute time-intensity sensory evaluation. This decrease in time can minimize the cost of conducting time-intensity tests, and still provide practical information on the time course of two sensory attributes.

In addition to providing the evaluation of interaction of tastes, and reducing the time and costs of evaluation, the dual-attribute time-intensity test provides solutions to at least two known methodological problems: dumping and inter-sample variability. Dumping occurs when a single attribute within a food is measured. The single attribute is rated as more intense when evaluated alone than when evaluated with additional attributes (Frank *et al.*, 1990). Lawless and Clark (1991) identified dumping as a problem during time-intensity testing, using the example of sweetness and strawberry flavour of strawberry/aspartame solutions. When panelists evaluated only the sweetness of the solution, the sample with the strawberry flavour was rated as more sweet than the sample without strawberry flavour. If both sweet and strawberry flavour of the solutions were evaluated, the sweetness rating was the same for both solutions. This bias can be minimized through dual-attribute time-intensity sensory evaluation. As well, dual-attribute time-intensity is useful for studying samples which have sample-to-sample variability, such as beef. Time-intensity work has been completed on the tenderness perception of beef (Duizer *et al.*, 1993). It has been difficult to study other characteristics in relation to tenderness because of the inherent variability within the muscle. Dual-attribute time-intensity can be used to study the relationship between tenderness and juiciness using only one sample of beef, overcoming the problem of variability between samples.

CONCLUSIONS

This research demonstrates that dual-attribute time-intensity allows collection of sensory data which more accurately reflects what is taking place in the mouth during consumption of a food. The success of the dual-attribute test in this research provides a tool for the study of many sensory interactions within foods. By quantifying interactions, the dual-attribute test can be used to study relationships such as juiciness and tenderness of meat, as well as other dynamic texture/flavour characteristics within food. Finally, dual-attribute testing can be accomplished in half the time required for single-attribute sensory evaluations. The method also offsets the problems of 'dumping' and sample variability. This initial dual-attribute research was conducted on chewing gum to provide a relatively long time for panelists to respond to intensity changes to reduce the potential for overloading the panelists. Since completing this study, further DATI research into meat tenderness and juiciness has been conducted collecting data successfully over time courses of 60–90 s. Panelists can readily perform DATI on relatively fast food events. It has been observed by panelists that dual-attribute testing is easier than single-attribute because they can shift their attention between the two attributes without concentrating too much on a single factor. It is this immediate sensory response that we are trying to measure without the filtering of cognitive process. The best-trained descriptive panelists respond at an automatic level to intensities. The same holds true for dual-attribute time-intensity.

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