

## EVALUATION OF BRAZILIAN LIGHT KETCHUPS I: TIME-INTENSITY AND CONSUMER ACCEPTANCE STUDIES

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In the present study samples of ketchup available on the Brazilian market (one traditional and three light versions) were evaluated for their sensory profile and consumer acceptance. The methodology used were the Time-Intensity (T-I) analysis and acceptance tests regarding appearance, flavor, aroma, texture and overall impression. Buying attitude and sweetness perception ('just-right' test) were also evaluated. The results of both T-I and acceptance tests showed that, among the light ketchups evaluated in this study, that sweetened with aspartame showed the highest sweetness equivalency and the most similar sensory profile compared to the one sweetened with sucrose. These results indicate that this sweetener, from the evaluated ones, is the most appropriate substitute for sucrose in this application. This was confirmed by the buying attitude and 'just-right' tests.

**KEY-WORDS:** LIGHT KETCHUP; SWEETENER; TIME-INTENSITY; SENSORIAL ANALYSIS.

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## 1 INTRODUCTION

Ketchup, catchup, or catsup is the product prepared from the liquid obtained from mature tomatoes of red or reddish varieties, which can be fresh or concentrated, seasoned with salt, vinegar, spices, flavorings, onions and garlic, sweetened with sugar, dextrose, corn or glucose syrup (which can include dried forms) or a mixture of these. Generally, granulated cane sugar or liquid sugar are used. Cinnamon, cassia, cloves, allspice, pepper, ginger, mustard and paprika are among the spices commonly used in ketchup. Spices may be used either in the form of whole spices, ground spices or volatile spice oils; an option is to use pre-prepared spice mixtures, specially designed according to precise specifications. Nearly every manufacturer of ketchup has an own formulation, which differs in some respect from those of other manufacturers, mainly regarding the quantity of spices or other flavoring agents used (GOULD, 1992).

According to the Brazilian law (BRAZIL, 2005), ketchup is a product made from mature fruits of *Lycopersicum esculentum* L. which can be added of other ingredients that do not interfere with the product characteristics. Ketchup is a popular food in Brazil, usually consumed together with fast-food (sandwiches, hamburger, hot dogs, french-fries, pizza) but also used as an ingredient in some culinary dishes. Sales of ketchup in Brazil in 2003 were around 31,000 tons, equivalent to US\$ 53,000.00 or R\$ 161.000,00 (AC NIELSEN, 2004).

The consumption of low calorie and reduced calorie foods has been a growing trend in modern societies, as people are more concerned with keeping a healthy lifestyle. Following this trend, the launching of new products in the diet/light segment is growing fast to attend this demand of "healthy foods" and, at the same time, offer new foods, with pleasant tastes, aromas and textures. According to the Brazilian Association of the Dietetic and Special Foods' Industry (ABIAD), the market of diet/light food in Brazil has grown from US\$ 160 million in 1990 to US\$ 3,000.00 million in 2003. This Association also reported that 20% of the Brazilian housewives are concerned with their families' health and, in about 35% of the Brazilian households, some diet/light food is consumed (ABIAD, 2004).

Sweeteners are key ingredients in the development of diet/light goods

to maintain the typical and pleasant sweet taste usually given by sucrose without adding as many calories as does this sugar. Sucrose is still the most widely used sweetener in foods and is always regarded as a reference when evaluating other sweet compounds (GODSHALL, 1990). The sweetness potential and taste profiles of high intensity sweeteners are usually not the same compared to sucrose. The differences between sugar and other sweet compounds are generally related to time-intensity (T-I) characteristics and after taste (LINDLEY, 2002).

T-I measurement is a special case of descriptive analysis, where a single characteristic is tracked as it changes over a determined period of time (PIGGOTT, SIMPSON & WILLIAMS 1998). T-I studies address the dynamic relationship between the onset, intensity and duration of perception of a sensory attribute. In practice, subjects are exposed to a stimulus and the perceived intensity is then recorded with the corresponding time coordinates until the intensity returns to zero again or the allocated time for the assessment has ended. These relationships are commonly illustrated in the form of T-I curves of perceived intensity versus corresponding time (LIU, MacFIE, 1990).

The first reports of tracking taste intensity over time started in the latest 1930s. After that, several authors made their attempts to quantify temporal responses to perceived sensory intensities. The opportunity to use computers for online data collection allowed to escape from manual measurements of T-I curves and, in the 1980s and 1990s the appearance of desktop computers led to an explosion in the use of T-I methodology. With the time, a variety of more reliable and automated hardware has been used (LAWLESS & HEYMANN, 1999; PIGGOTT, SIMPSON & WILLIAMS 1998).

LARSON-POWERS & PANGBORN (1978) made T-I measurements to evaluate beverages and gelatins sweetened with sucrose, saccharin, cyclamate and aspartame. BIRCH & MUNTON (1981) used a potentiometer as an input device for recording T-I curves, a method called Sensory Measuring Unit for Recording Flux (SMURF). A strip chart recorder was used by OTT, EDWARDS & PALMER (1991) to evaluate sweet and bitter taste of aspartame, acesulfame-K and alitame compared to sucrose. Computerized T-I systems were used by MATYSIAKE & NOBLE (1991) and by KETELSEN, KEAY & WIET

(1993) to compare the temporal perception of taste attributes in model systems sweetened with high intensity sweeteners (aspartame, acesulfame-K, cyclamate and saccharin), compared to sucrose.

CARDELLO & FARIA (1999) evaluated 'aguardente', a typical Brazilian drink made from fermented sugar cane, through T-I curves, using a computerized system with a program called Time-Intensity Data Acquisition System for Windows (SCDTI). Software called "T-I.exe" was used by CALVIÑO & GARRIDO (2000) to evaluate the potency of the sweetness of aspartame, D-tryptophan and thaumatin. PIGGOTT, HUNTER & MARGOMENOU (2000) evaluated scotch malt whisky through T-I data, using a computerized tool called PSA-system. The SCDTI program was also used to compare the sweetness profile of traditional and low-calorie peach nectars (UJIKAWA & BOLINI, 2004).

Acceptance testing, which means measuring liking or preference for a product, is a valuable and necessary component of every sensory study. Scaling methods allow to directly measure the degree of liking and to compute preferences from the data. The two methods most frequently used for these purposes are the paired comparison test and the nine-point hedonic scale (STONE & SIDEL, 1993). According to MEILGAARD, CIVILLE & CARR (1999) the conduction of consumer tests usually falls into one of the following purposes: product maintenance, product improvement/optimization, development of new products and assessment of market potential.

Another type of hedonic scale is a just-right, or just-about-right (JAR) scale, which is used to measure the pleasantness or desirability of the intensity of a specific attribute. These scales are frequently used to determine the optimum level of an ingredient in a product. An example of JAR scale would be a line labeled "just right" in the center, "much too sweet" at one end and "not nearly sweet enough" at the other end (VICKERS, 1988). These scales have been used to identify attributes that need improvement and to determine the optimum level for an attribute in a product (EPLER, CHAMBERS & KEMP, 1988). As explained by STONE & SIDEL (1993), JAR scales combine attribute intensity and preference in a single response.

The objective of this study was to compare the time-intensity curves, consumer acceptance, ideal sweetness and consumer buying attitude

of 4 commercial ketchups, one sweetened with sucrose and 3 sweetened with high intensity sweeteners (aspartame; acesulfame-k; cyclamate/saccharin/stevia). No studies were found in the literature regarding the application of time-intensity tests to this kind of product.

## **2 MATERIAL AND METHODS**

### **2.1 PRODUCTS**

The products studied were commercial ketchup samples, which were purchased in supermarkets, in the city of Campinas-SP (Brazil). Four different products were evaluated:

- Brand 1: regular ketchup, sweetened with sucrose (SUC);
- Brand 2: light ketchup, sweetened with aspartame (APM);
- Brand 3: light ketchup, sweetened with acesulfame-K (ACE);
- Brand 4: light ketchup, sweetened with cyclamate, saccharin and stevia (CSS).

### **2.2 TIME-INTENSITY ANALYSIS**

#### **2.2.1 Selection of panelists**

A previous selection was conducted in order to compose the time-intensity (T-I) analysis' panel. For this purpose, sequential analysis, using triangular difference tests with 2 light ketchups were carried out in relation to sweetness and with significant difference of 0,1% (MEILGAARD CIVILLE & CARR, 1999). Eight candidates were selected to perform the T-I analysis, based on their ability to discriminate differences between samples, to reproduce results and also to be in agreement with the rest of the panel. These aspects were evaluated through analysis of variance of 2 factors (sample and repetition) for each panelist and for the two attributes to be evaluated in the T-I analysis: sweetness and overall tomato flavor. Another aspect considered in this selection was the ability of the participants for the interactive test with the computer. The selected panel was trained in 4 sessions, to perform the T-I trials.

#### **2.2.2 Time-intensity trials**

The T-I tests were performed for each of the attributes (sweetness and

overall tomato taste). The samples were codified with 3-digit numbers and served in monadic sample presentation, with 3 repetitions at the Sensory Analysis Laboratory (STONE & SIDEL, 1993). The samples were served in table spoons (2 mL portions), in balanced order. All the panelists assessed the 4 samples.

The T-I data were collected using the Time-intensity Data Acquisition System (SCDTI) program, developed in the Laboratory of Sensory Analysis of the Universidade Estadual de Campinas (CARDELLO et al., 2003). Through this program, the intensity of the stimulus was registered over time in a graphic structuralized 9 points scale, using the 'mouse'. After the first sound emitted by the computer, the panelist was instructed to put the sample in the mouth, after the second sound to swallow the sample and the third sound indicated that the analysis was over. During these steps, each panelist recorded the intensity of the evaluated attributes in the 9-point scale of the computer. With the generated data, T-I curves were constructed, with the following parameters: Maximum perceived intensity ( $I_{max}$ ); Time for maximum intensity ( $T_{I_{max}}$ ); Total duration time ( $T_{tot}$ ); Total area under the curve (Area). The results of the T-I analysis were evaluated through linear regression and principal component analysis.

### 2.3 CONSUMER ACCEPTANCE TRIALS

Consumer acceptance tests were carried out in relation to appearance, aroma, taste, texture and overall global impression. For these tests, 30 judges were requested to evaluate each sample, using a hedonic structuralized scale of 9 cm. All the participants evaluated all the samples in monadic presentations and in balanced order. The ketchup samples (2 mL portions) were served on white bread.

In this trial respondents were also asked to report their buying attitude regarding each sample, using a purchase attitude 5-points scale (MEILGAARD, CIVILLE & CARR, 1999) and also their impression regarding the sweetness of each sample, in this case using a "just-about-right" 9-points scale (VICKERS, 1988).

### 2.4 DATA ANALYSIS

In the selection of the panelists for the T-I analysis, a two-factor analysis

of variance (ANOVA) (sample and repetition) was used for each person, regarding each attribute. The participants with significant  $F_{\text{sample}}$  values ( $p < 0,30$ ) and  $F_{\text{repetition}}$  ( $p > 0,05$ ) were selected. The data of the parameters obtained from the T-I curves were evaluated through analysis of variance (ANOVA), Turkey's test of averages and principal component analysis (PCA). For the statistical analysis, the SAS program was used (SAS, 2003).

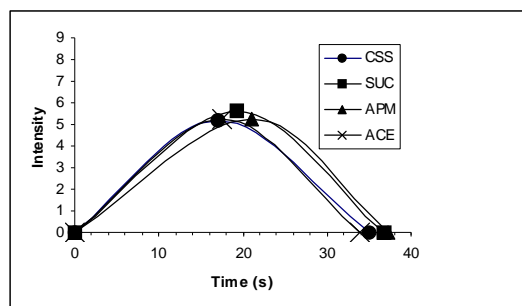
The results obtained in the acceptance analysis were evaluated by analysis of variance (ANOVA) and Turkey's average test. The buying attitude and the sweetness impression were both evaluated by "bar" graphs, according to the percentage of each answer.

### 3 RESULTS AND DISCUSSION

#### 3.1 TIME - INTENSITY ANALYSIS

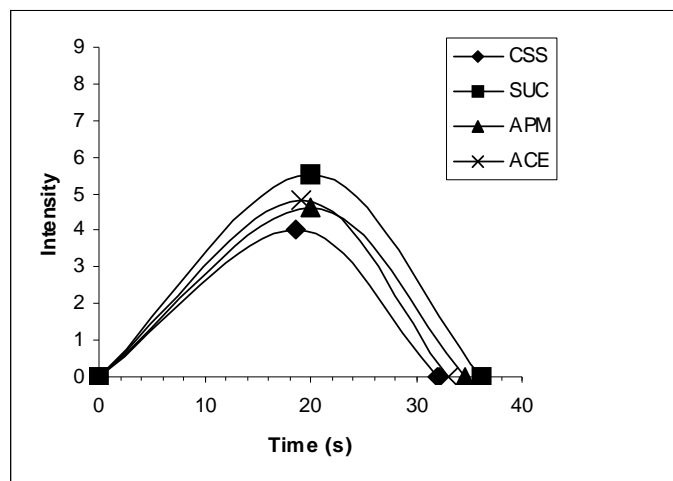
The T-I curves for sweetness and tomato flavor are shown in Figures 1 and 2, respectively. The parameters obtained from these curves were statistically analyzed. Panel's means and their minimum significant difference values obtained through Turkey's test ( $p \leq 0.05$ ) are expressed in Tables 1 and 2.

**FIGURE 1 - TIME-INTENSITY CURVE FOR KETCHUP SWEETNESS**



SUC = regular ketchup, sweetened with sucrose; APM = light ketchup, sweetened with aspartame; ACE = light ketchup, sweetened with acesulfame-K; CSS = light ketchup, sweetened with cyclamate, saccharin and stevia.

**FIGURE 2 - TIME-INTENSITY CURVE FOR KETCHUP TOMATO FLAVOR**



SUC = regular ketchup, sweetened with sucrose; APM = light ketchup, sweetened with aspartame; ACE = light ketchup, sweetened with acesulfame-K; CSS = light ketchup, sweetened with cyclamate, saccharin and stevia.

**TABLE 1 - TIME - INTENSITY CURVE'S PARAMETERS MEANS FOR KETCHUP REGARDING TO SWEETNESS**

Sample	Tlmax (s)	Area	Ttot (s)	lmax
CSS	17.066 <sup>b</sup>	89.90 <sup>a</sup>	35.094 <sup>a</sup>	5.215 <sup>a</sup>
SUC	19.203 <sup>ab</sup>	110.13 <sup>a</sup>	36.721 <sup>a</sup>	5.624 <sup>a</sup>
APM	21.070 <sup>a</sup>	103.45 <sup>a</sup>	37.239 <sup>a</sup>	5.254 <sup>a</sup>
ACE	17.484 <sup>ab</sup>	99.42 <sup>a</sup>	33.939 <sup>a</sup>	5.230 <sup>a</sup>

Note: The means with the same letters within a column indicates that there is no significant difference between the samples.

SUC = regular ketchup, sweetened with sucrose; APM = light ketchup, sweetened with aspartame; ACE = light ketchup, sweetened with acesulfame-K; CSS = light ketchup, sweetened with cyclamate, saccharin and stevia.  $I_{max}$  = Maximum perceived intensity;  $Tl_{max}$  = Time for maximum intensity;  $T_{tot}$  = Total duration time; Area = Total area under the curve.



**TABLE 2 - TIME - INTENSITY CURVE'S PARAMETERS MEANS FOR KETCHUP REGARDING TO TOMATO FLAVOR**

Sample	T <sub>max</sub> (s)	Area	T <sub>tot</sub> (s)	I <sub>max</sub>
CSS	18.621 <sup>a</sup>	70.08 <sup>b</sup>	32.013 <sup>a</sup>	4.009 <sup>c</sup>
SUC	19.982 <sup>a</sup>	105.377 <sup>a</sup>	36.243 <sup>a</sup>	5.520 <sup>a</sup>
APM	20.001 <sup>a</sup>	86.301 <sup>b</sup>	34.540 <sup>a</sup>	4.619 <sup>bc</sup>
ACE	19.167 <sup>a</sup>	81.998 <sup>b</sup>	33.083 <sup>a</sup>	4.807 <sup>b</sup>

Note: The means with the same letters within a column indicates that there is no significant difference between the samples.

SUC = regular ketchup, sweetened with sucrose; APM = light ketchup, sweetened with aspartame; ACE = light ketchup, sweetened with acesulfame-K; CSS = light ketchup, sweetened with cyclamate, saccharin and stevia. I<sub>max</sub> = Maximum perceived intensity; T<sub>max</sub> = Time for maximum intensity; T<sub>tot</sub> = Total duration time; Area = Total area under the curve.

Regarding to sweetness, the samples presented no significant difference in relation to the parameters of the T-I curve, except by T<sub>max</sub>, for which the samples CSS and APM presented significant difference. The sample sweetened with sucrose (SUC) showed the highest means for I<sub>max</sub> and Area, while the highest means for T<sub>max</sub> and T<sub>tot</sub> were observed for the sample APM. ACE and CSS did not present significant difference in any of the parameters.

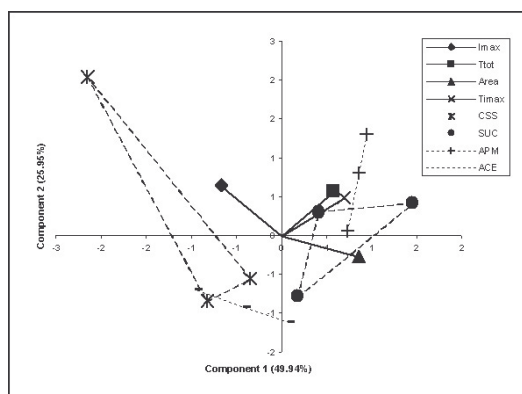
For tomato flavor, the three samples added of sweeteners (APM, ACE and CSS) differed significantly from the one formulated with sucrose (SUC) in the parameters I<sub>max</sub> and Area. For both these two parameters, SUC showed the highest means out of the 4 samples. APM, on the other hand, did not present significant difference from CSS and ACE for any of the parameters.

As observed for sweetness, no significant difference was observed between ACE and CSS for tomato flavor, except for I<sub>max</sub>, for which ACE's mean was higher than CSS's. Also for tomato flavor, APM was the most similar sample compared to SUC for most of the parameters of the T-I curve, besides presenting significant difference in some of

them. The highest values of  $I_{max}$ ,  $T_{tot}$  and Area observed for SUC regarding to tomato flavor might suggest that sucrose does not interfere in the tomato flavor as the evaluated sweeteners probably do, possibly due to its clean sweet taste, without after-taste.

With the parameters collected for each sample and judge, principal component analysis (PCA) were carried out for sweetness and tomato flavor and the results are presented in Figures 3 and 4.

**FIGURE 3- PRINCIPAL COMPONENTS ANALYSIS FOR SWEETNESS OF COMMERCIAL KETCHUP SAMPLES**



SUC = regular ketchup, sweetened with sucrose; APM = light ketchup, sweetened with aspartame; ACE = light ketchup, sweetened with acesulfame-K; CSS = light ketchup, sweetened with cyclamate, saccharin and stevia.  $I_{max}$  = Maximum perceived intensity;  $T_{max}$  = Time for maximum intensity;  $T_{tot}$  = Total duration time; Area = Total area under the curve.

PCA for sweetness (Figure 3) showed that 49.94% of the variability between the samples is explained by the principal component 1 and 25.95% by the principal component 2. All the T-I curve's parameters contributed to the variability explained by component 1:  $T_{tot}$ ,  $T_{max}$  and Area contributed positively and  $I_{max}$  negatively. For component 2, all the parameters contributed positively, except for Area.

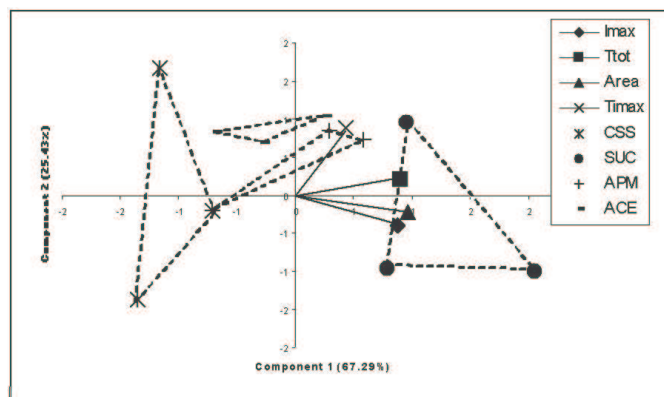
The samples SUC and APM were both characterized by the parameters

Area, Ttot and Tlmax and the proximity between them in the graph indicates a similar behavior regarding to sweetness perception. CSS was characterized only by I<sub>max</sub> and ACE was not explained by any of the parameters.

PCA for tomato overall flavor (Figure 4) showed that 67.29% of the variability between the samples is explained by the principal component 1 and 25.43% by the principal component 2. All the T-I curve's parameters contributed positively to the variability explained by principal component 1. For component 2, Tlmax and Ttot contributed positively and I<sub>max</sub> and Area negatively. In relation to tomato flavor, SUC was characterized by all the parameters, while CSS was not explained by any of them. ACE was explained by Tlmax and APM was mainly explained by Tlmax and Ttot.

For both sweetness and tomato flavor, APM was the sample that showed the most similar behavior compared to SUC.

**FIGURE 4 - PRINCIPAL COMPONENTS ANALYSIS FOR TOMATO FLAVOR OF COMMERCIAL KETCHUP SAMPLES**



SUC = regular ketchup, sweetened with sucrose; APM = light ketchup, sweetened with aspartame; ACE = light ketchup, sweetened with acesulfame-K; CSS = light ketchup, sweetened with cyclamate, saccharin and stevia. I<sub>max</sub> = Maximum perceived intensity; T<sub>lmax</sub> = Time for maximum intensity; T<sub>tot</sub> = Total duration time; Area = Total area under the curve.

### 3.2 CONSUMER PREFERENCE TEST

Consumer acceptance means obtained for the four commercial samples of ketchup are presented in Table 3.

In terms of appearance, ACE was significantly different from the other samples, with the lowest mean. No significant difference was observed among the other samples for this parameter. In relation to aroma, the lowest mean was observed for ACE, but no significant difference was obtained for this sample compared to CSS. Also, no significant difference was verified for APM, SUC and CSS in terms of aroma. Regarding to flavor, the lowest mean was showed by CSS, followed by ACE, this last one not being significantly different from either APM or CSS. Only APM did not differed significantly from SUC in this parameter.

**TABLE 3 - CONSUMER ACCEPTANCE PARAMETERS MEANS OF CATCHUP**

Sample	Appearance	Aroma	Flavor	Texture	Overall Impression
CSS	6.408 <sup>a</sup>	4.900 <sup>ab</sup>	3.700 <sup>c</sup>	4.572 <sup>b</sup>	4.100 <sup>b</sup>
SUC	6.454 <sup>a</sup>	5.900 <sup>a</sup>	6.084 <sup>a</sup>	6.502 <sup>a</sup>	6.432 <sup>a</sup>
APM	5.762 <sup>a</sup>	5.848 <sup>a</sup>	5.714 <sup>ab</sup>	6.218 <sup>a</sup>	5.214 <sup>ab</sup>
ACE	3.402 <sup>b</sup>	4.686 <sup>b</sup>	4.560 <sup>bc</sup>	4.982 <sup>b</sup>	4.492 <sup>b</sup>

Note: The means with the same letters within a column indicates that there is no significant difference between the samples.

SUC = regular ketchup, sweetened with sucrose; APM = light ketchup, sweetened with aspartame; ACE = light ketchup, sweetened with acesulfame-K; CSS = light ketchup, sweetened with cyclamate, saccharin and stevia.

In terms of texture, ACE and CSS were not significantly different, but both of them showed lower means and were significantly different from the samples APM and SUC. These last two ones, on the other hand, did not present significant difference. Finally, regarding to the overall

impression, no significant difference was obtained for APM, ACE and CSS (lower means were obtained for CSS, followed by ACE), but only APM was not significantly different from SUC in this aspect.

No significant difference was observed between the samples SUC and APM in any of the consumer acceptance parameters. Also, SUC was the sample that presented higher means for all the evaluated parameters, always followed by APM, except by appearance, in which CSS got the highest mean after SUC.

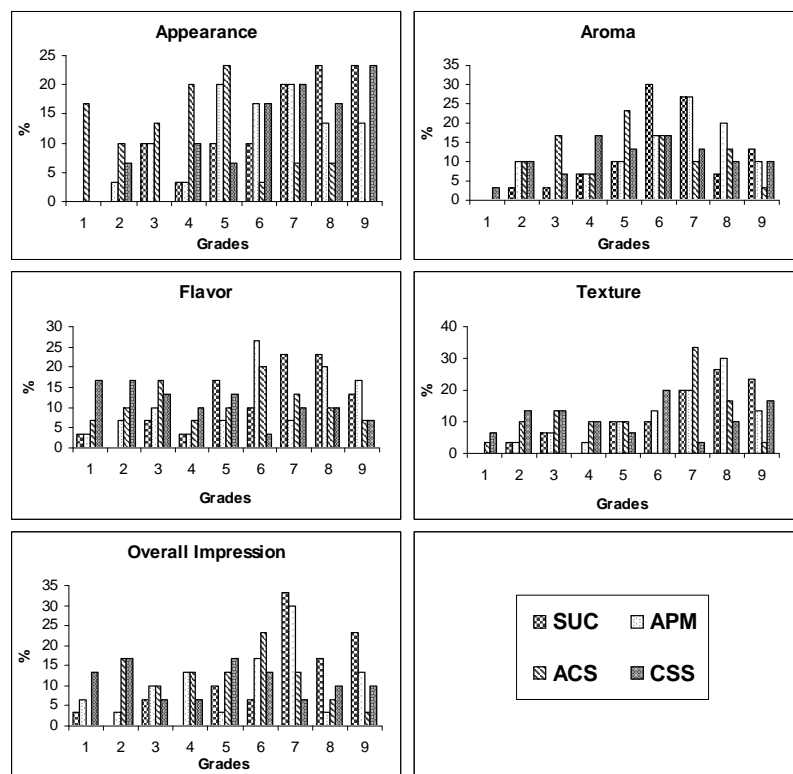
The analysis of the grades distribution histograms (Figure 5) shows that aroma, flavor and overall impression acceptance grades to SUC and APM are concentrated in the region between the grades 6 and 9, clearly indicating good consumer's acceptance.

ACE appearance grades were concentrated between 1 and 5, showing bad consumer's acceptance; as showed in Table 3, this sample was significantly different from SUC in all the evaluated parameters. CSS presented a spread distribution of grades, indicating that the acceptance varied through to the scale extension.

The results showed that the sample sweetened with aspartame presented a superior acceptance, which could be compared to the acceptance of the traditional product (sweetened with sucrose).

As shown in the bar graphs regarding the sweetness perception (Figure 6), the traditional ketchup was considered "just right" by more than 1/3 of the participants, "very little sweeter than ideal" by 20% of them and "little sweeter than the ideal" by 13% of the judges. The sweetness of the APM sample was regarded as "ideal" by half of the respondents and "very little less sweet than the ideal" by 27% of them. In the case of the ACE sample, most of the judges considered its sweetness "ideal" (27%) or "very little less sweet than the ideal" (20%). The sample sweetened with the blend CSS, on the other hand, was considered "not nearly sweet enough" by 23% of the participants, "much too sweet" by 20% of them and "very little sweeter than the ideal" by 23% of the judges, so there was not any consensus in terms of sweetness perception for this last sample, while the other 3 samples seemed to be close to the ideal sweetness, according to the interviewed consumers.

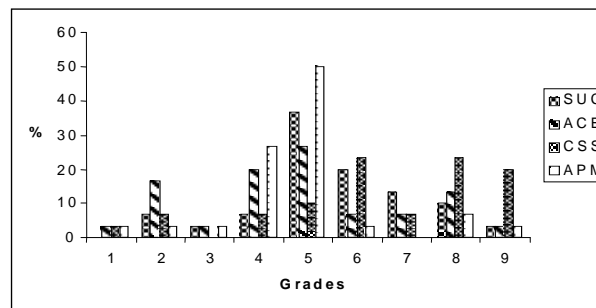
**FIGURE 5 - HISTOGRAM OF GRADES GIVEN IN RELATION TO THE HEDONIC SCALE FOR COMMERCIAL KETCHUP SAMPLES**



SUC = regular ketchup, sweetened with sucrose; APM = light ketchup, sweetened with aspartame; ACS = light ketchup, sweetened with acesulfame-K; CSS = light ketchup, sweetened with cyclamate, saccharin and stevia.

Regarding the buying attitude (Figure 7), a general positive attitude was observed for the sample sweetened with sucrose. For the APM sample, half of the judges showed a positive attitude, but the product was rejected by 27% of the participants. The negative attitude for the product sweetened with acesulfame-K was higher than the positive one and, for the sample sweetened with the blend CSS, only 21% of the respondents reported a positive intention, while half of them rejected the sample.

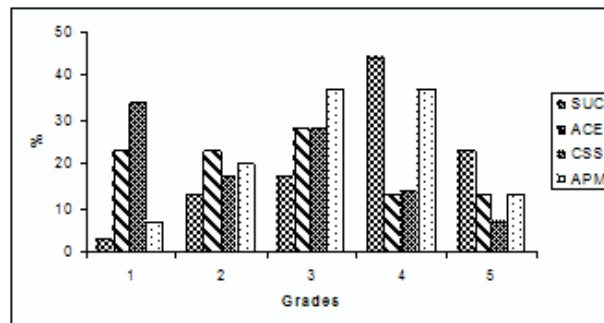
**FIGURE 6- HISTOGRAM OF GRADES FOR CONSUMER ACCEPTANCE TESTS REGARDING TO SWEETNESS PERCEPTION**



1 = not nearly sweet enough; 2 = less sweet than the ideal; 3 = little less sweet than the ideal; 4 = very little less sweet than the ideal; 5 = just right; 6 = very little sweeter than the ideal; 7 = little sweeter than the ideal; 8 = sweeter than the ideal; 9 = much too sweet.

SUC = regular ketchup, sweetened with sucrose; APM = light ketchup, sweetened with aspartame; ACE = light ketchup, sweetened with acesulfame-K; CSS = light ketchup, sweetened with cyclamate, saccharin and stevia.

**FIGURE 7- HISTOGRAM OF GRADES FOR CONSUMER ACCEPTANCE TESTS REGARDING TO BUYING ATTITUDE**



1 = I would certainly not buy this product; 2 = I would probably not buy this product; 3 = I'm not sure if I would buy this product or not; 4 = I would probably buy this product; 5 = I would certainly buy this product.

SUC = regular ketchup, sweetened with sucrose; APM = light ketchup, sweetened with aspartame; ACE = light ketchup, sweetened with acesulfame-K; CSS = light ketchup, sweetened with cyclamate, saccharin and stevia.

#### 4 CONCLUSION

The results of this study indicate that aspartame presented similar T-I profile compared to sucrose when evaluated in ketchup. The sample sweetened with sucrose had the highest  $I_{\max}$ ,  $T_{\text{tot}}$  and Area for tomato flavor, what suggests that sucrose does not interfere with tomato flavors, as might do the other sweeteners evaluated. The superior acceptance of the light ketchup sweetened with aspartame and its similarity to the regular one were confirmed by the sweetness ideal and buying attitude. Based on the main findings it can be concluded that aspartame is the most suitable substitute for sucrose in ketchup, compared to the other sweeteners evaluated in this study.

#### **AVALIAÇÃO DE CATCHUP LIGHT BRASILEIROS I: CARACTERÍSTICAS TEMPO-INTENSIDADE E ACEITAÇÃO POR CONSUMIDORES**

Neste estudo, amostras de catchup disponíveis no mercado brasileiro (uma versão tradicional e três lights) foram avaliadas quanto ao perfil sensorial e à aceitação por consumidores. As metodologias utilizadas foram a análise tempo-intensidade (T-I) e testes de aceitação quanto à aparência, aroma, sabor, textura e impressão global. A atitude de compra em relação aos produtos e a percepção de dulçor (escala do ideal) também foram avaliadas. Os resultados da análise T-I e dos testes de aceitação demonstraram que o catchup light adoçado com aspartame apresentou maior equivalência de dulçor e perfil sensorial mais próximo ao do produto adoçado com sacarose. Concluiu-se que dentre os edulcorantes avaliados, o aspartame é o mais apropriado para essa aplicação. Tal observação foi confirmada pelos testes de atitude de compra e escala do ideal.

**PALAVRAS-CHAVE:** CATCHUP - LIGHT; TEMPO-INTENSIDADE; ANÁLISE SENSORIAL; EDULCORANTES.

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