Preferences identification of consumers of snacks through the analysis of the frequencies of the sensory dominance

Piccoli, Bruno[1]; Recchia, Annamaria[2]; Zoboli, Gian Paolo[3]; Dinnella, Caterina[4]

[1]Adacta International S.p.A., Naples, Italy, bPiccoli@adactainternational.org
[2]Adacta International S.p.A., Naples, Italy, annamaria.recchia@adactainternational.com
[3]Adacta International S.p.A., Naples, Italy, zoboli@adactainternational.com
[4]Department of Agricultural Biotechnology, University of Florence, Florence, Italy, caterina.dinnella@unifi.it

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Introduction

Sensory sciences provide methods that enable to evoke, measure, analyse and interpret the characteristics of the products that can be perceived with the sense organs. Among the most recent and important applications, there are the dynamic objective tests, aimed at describing the time dependence of the sensory perception. Indeed, the product taste is - since first bite to swallowing and beyond - definitely an evolving phenomenon, whose characteristics gradually changes according to the time variable. Through the application on a real case-study, we suggested an innovative analytic approach to this type of data.

With an increasing interest, over the last years industrial snacks have been more and more present in the Italians' cupboards. The fact of being a very handy type of product and the wide range of sensory offers on this market have allowed manufacturers to adequately meet the extremely heterogeneous demand. In this context, producers particularly focus on the cocoa/chocolate snacks.

By defining the dynamic profile (Temporal Dominance of Sensations) of some of the most successful cocoa snacks available on the market, the knowledge of preference trends and tendencies of consumers of this type of product was investigated.

In particular, the use of objective information about the duration and prevalence of sensory perceptions for the construction of an external preference map offered an alternative interpretation that is very useful in the study of consumers' sensory preferences.

Materials and methods

11 industrial cocoa/chocolate snacks – among the most popular ones available on the market and representatives of the main brands in this sector – were examined. A sample of 300 usual consumers of these products was required to express - in blind conditions during 3 in-home interviews - an opinion on their appreciation of each product. The evaluation order was different from respondent to respondent, according to a completely randomized experimental plan.

Consumers – belonging to an age group between 5 and 34 years - were balanced per gender and equally distributed in the cities of Milan, Bologna, Rome and Naples.

Contemporarily, the snacks were analyzed by a panel of 10 expert assessors which described the temporal evolution of the specific sensory attributes through the application of the TDS (Temporal Dominance of Sensations) technique.

In details, in apposite preliminary sessions, modes and duration of the taste – established in 90 seconds – were defined and shared. Furthermore, 13 “potentially” dominant - that is capable of capturing the consumer's attention and to "dictate" the judgment of appreciation - sensory attributes (*mellowness; creaminess; dryness; softness; graininess; chocolate pieces (texture); chocolate/cocoa; alcohol; milk; hazelnut; sponge cake; bitter; sweet*) were identified. The accurate surveys in the booths – which followed the preliminary phase of analysis and alignment – were replicated for 4 times.

The statistical significance of the differences among the different average liking scores given to the products at Table1 was identified through the one-way analysis of variance (One – way ANOVA; alpha = 0,05) and the least significant difference test (LSD test, alpha = 0,05). The individual's belonging to a specific segment of preference, however, was obtained using a non-hierarchical clustering algorithm (K - means).

After a preliminary qualitative (visual) exam of the curves of dominance, the sensory evaluation period (90 seconds) was decomposed into three intervals (0-20 sec; 21-55 sec; 56-90 sec).

Within each interval, the attributes with a higher level of dominance than the case were selected. Then, the dominance was expressed in terms of frequency values. Starting from the latter - through a PCA (Principal Component Analysis) of the objective profiles - the dominance sensory map (Fig.2) of the product was obtained, whereas the relations between the consumer’s judgment and the intrinsic characteristics of the products were investigated through an external preference map (PCR – Principal Component Regression). Finally, through a simple linear regression, the detailed analysis in Fig.3 was built.

Results and discussion

The consumer makes a clear distinction between the more and the less appreciated snacks overall, as shown by the result for the total sample in Table 1.

The ranking shows a rather wide gap between the most appreciated products (A, B and C) and the less appreciated ones (H, I, J, K). The extent of this distance is even clearer if we consider that the evaluation scale consists of 9 points (1-9), but the evaluations tend to be concentrated on the top, because of the hedonic role of this specific category.

The differences in terms of taste/aroma and texture are at the base of the different level of average appreciation expressed by respondents. In fact, the set of products under

consideration - although composed of snacks that have all a "chocolate" characterization - is characterized by very diversified sensory properties.

Always in Table1, you can see the preferences segmentation that enabled to identify three sub-groups of consumers with partially different tendencies.

	Overall liking	Cluster 1 (41%)	Cluster 2 (35%)	Cluster 3 (24%)
Product A	7,9	8,3	7,7	7,3
Product B	7,8	8,2	7,5	7,2
Product C	7,8	7,8	8,0	7,3
Product D	7,6	7,5	7,6	7,6
Product E	7,5	7,5	7,9	7,1
Product F	7,4	7,6	7,3	7,4
Product G	7,4	7,5	7,5	7,3
Product H	6,8	7,7	5,6	7,2
Product I	6,8	6,1	7,1	7,5
Product J	6,5	6,4	6,2	7,0
Product K	6,2	6,1	5,8	6,9
**lsd*	*0,2*	*0,3*	*0,4*	*0,4*

Table1. *Products liking in blind conditions (end-anchored 9-point scale)*

The most numerous groups – cluster 1 and 2 – show a greater discriminatory power. In particular, 41% of respondents appreciates more openly A and B, penalizing without hesitations I, J and K. The second group, on the other hand, rewards snacks as C and E, and probably they would not consume H and K. A quota of 24% is always quite satisfied and has a less clear position than the others.

The next step was to identify – through the study of the dominance profiles – the temporal sequence of the perceptions that are more similar to the different consumers' clusters during the taste.

This objective was pursued, first through the schematization of the evolution of the sensory profile into the above-mentioned three sub-periods. This made it possible to express the attribute dominance in terms of frequency values, namely the number of times the panel indicated a certain attribute was dominant. This transformation, together with an articulated and necessary procedure of validation of the original matrix of data, enabled to carry out also statistical comparisons between the curves of dominance.

In Fig.1, the frequency values are represented in the form of spheres, with an amplitude that is proportional to the relative percentage of dominance.

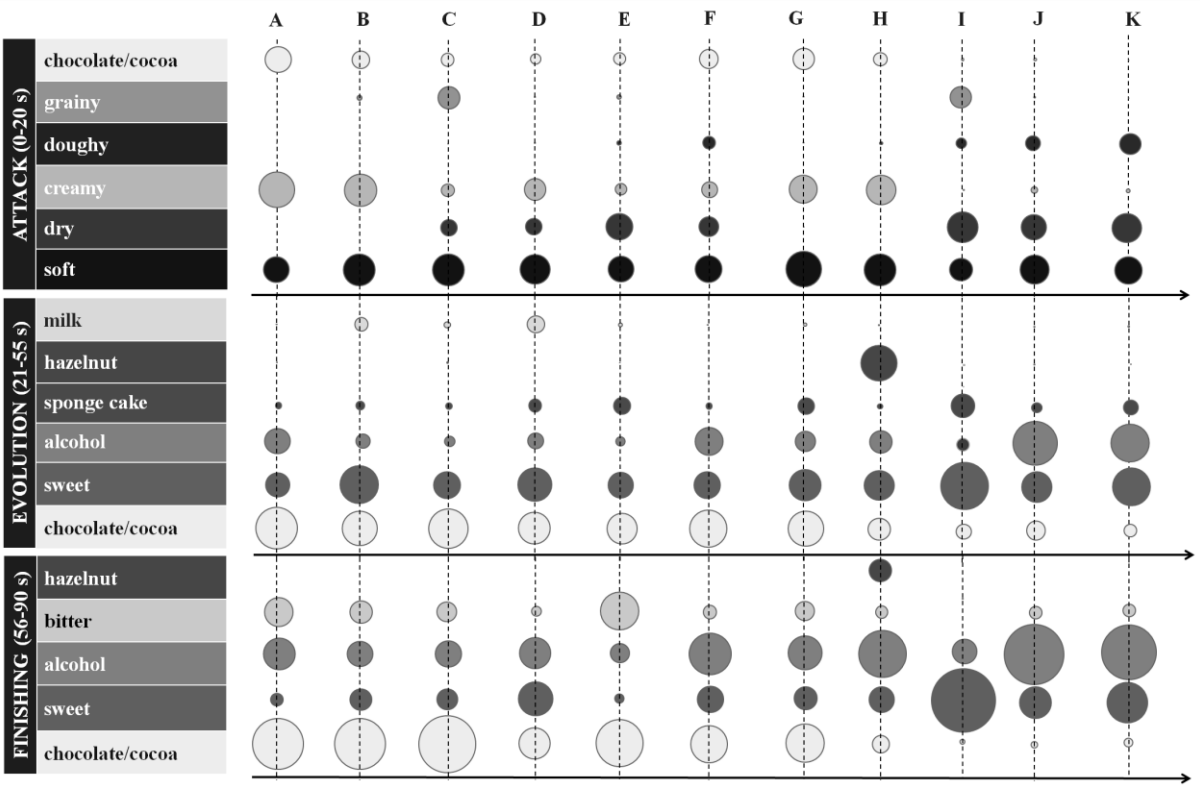

Figure 1. *Domino graph – amplitude proportional to the dominance*

In particular, this quantitative approach to the analysis of the TDS curves enabled to realize the map in Fig.2, where each product finds a place in the space according to its dominance profile.

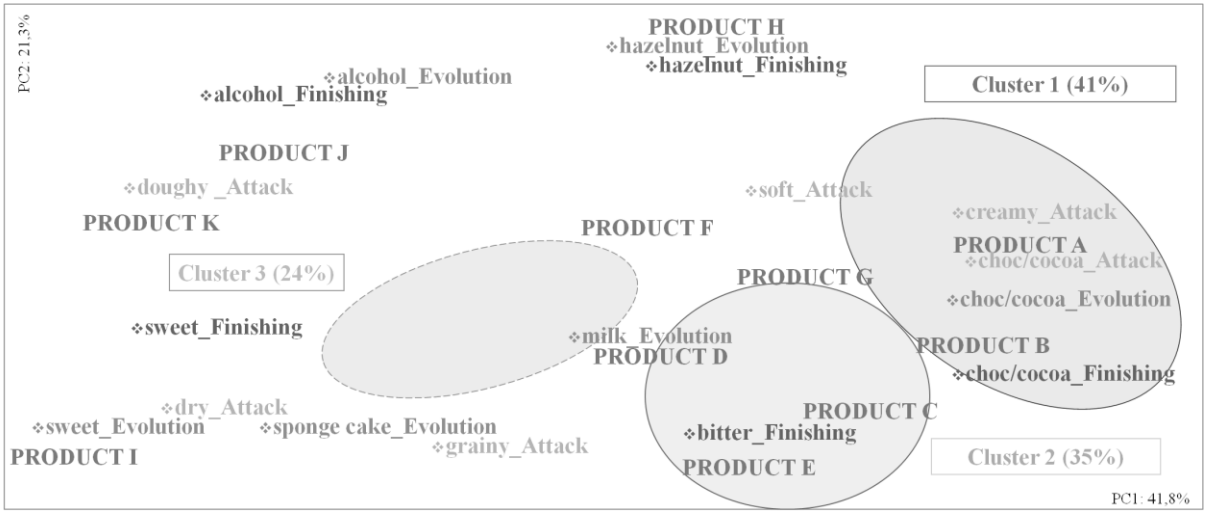

Figure 2. *Dominance sensory map (external preference mapping)*

The concomitant projection of the three segments of individual consumers (PCR), enables to identify the product characteristics at the base of the peculiar preferences expressed. In details, CL1 prefers A and B because they are particularly rich, with a strong taste of chocolate/cocoa since the first swallowing, with a very creamy and not dry structure and a not particularly sweet aftertaste. Another part (CL2) – however – seems to tend towards products with a more bitter chocolate, with a structure that, initially, is less creamy (E, C). This consumer - as shown in the regression graphs in Fig.3 - definitely rejects the perception of alcohol in the finishing phase (F, H, J, K). 24% (CL3) - though less able to discriminate - however shows not to reward in a particular way richer and more chocolaty products (D, I, F).

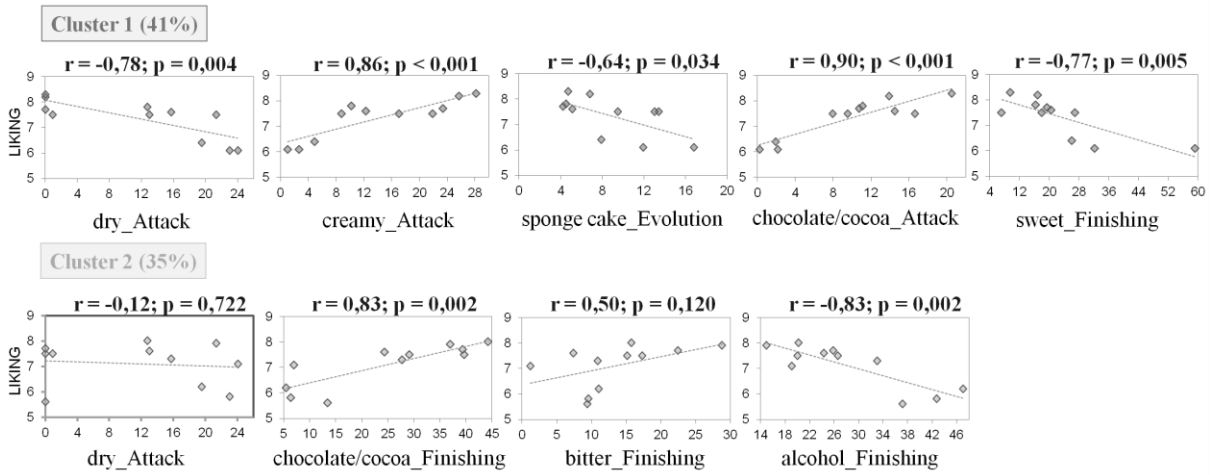

***Figure 3**. Distinctive liking profile*

Conclusions

The transformation of the dominance curves in frequency values for the period proved to be an innovative procedure, very useful both to assess the significance of the difference among products and, above all, to better understand the sensory preferences of consumers. Indeed, the TDS analysis takes into account all the interactive phenomena which occur during the taste and it focuses only on the "dominant" attributes, exactly those on which, most likely, also consumers focus their attention.

The conversion into frequency values of dominance of the TDS curves, furthermore, can enable an accurate integration with other types of data, coming, for example, from QDA (Quantitative Descriptive Analysis) or instrumental analysis.

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