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Sensory determinants of refreshing

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Abstract

To better understand how different sensory attributes combine to produce a refreshing sensation, we used a gel model system to vary the composition of ingredients selected to modulate the refreshing sensation: cooling agent, citric acid, peach and mint flavourings and xanthan. A group of 160 target consumers rated the refreshing intensity of the gels and a trained sensory panel evaluated the sensory properties of the same gels using Quantitative Descriptive Analysis®. An internal preference mapping methodology was applied to identify the contribution of the products' sensory characteristics to the refreshing scores given by consumers. Consumers agreed quite well on the least refreshing gels which were the sweetest, but they differed regarding the sensory drivers of the most refreshing gels. Three segments of consumers were identified for which refreshing was driven mainly by perception of cold/mint, acid and thickness, respectively. Food habits may be partly responsible for the different key sensory drivers among consumer clusters.

Keywords: Refreshing; Consumer test; Trained panel; Psychophysics

1. Introduction

Sensory determinants of complex perceptions such as refreshing, fresh, fatty or natural are multiple, involving olfaction, taste and texture modalities. In addition, physiological, psychological or social factors strongly modulate these perceptions. When looking at refreshing in the dictionary, the following definition can be found: *To restore strength and animation, to revive, to arouse, to stimulate, to run water over or restore water to, with thirst-quenching properties* (Merriam-Webster Dictionary & Thesaurus, 2006). According to this definition, refreshing seems to be mainly induced by water. Liquids may therefore be expected by consumers to be more refreshing than solids. This assumption is confirmed by a study (Zellner & Durlach, 2002) showing that, when asked to list ten foods or beverages they found refreshing, 86 American students most frequently listed water (90% of respondents). The students were also asked to *list ten characteristics of refreshing foods or beverages*. Results showed that temperature related attributes (cool, cold) were the sensory characteristics the most commonly reported (92% of respondents). A study conducted on beers with a wide range of sensory characteristics highlighted that the cooling sensation induced by beers was positively correlated to its refreshing sensation (Guinard, Souchard, Picot, Rogeaux, & Sieffermann, 1998). In addition, a study on freshness in oral care recently showed the association made by consumers between coldness and refreshing sensation (Westerink & Kozlov, 2004). In the latter study, freshness has the same meaning as refreshing in our work. Through subject interviews, the authors highlighted the different sensory, physiological and cognitive factors that contribute to oral freshness including "cool/coldness" and "taste" more often described by "menthol or mint" but also "citrus" by few participants. Citrus and peach have been reported elsewhere as fruit aromas associated with refreshing (Martin et al., 2005). The perceived or expected acidity of the fruits may explain why they are perceived as being refreshing. Acid perception has indeed been

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reported as a positive driver of refreshing characteristics in beverages (McEwan & Colwill, 1996).

Besides positive drivers of refreshing sensation (coldness, mint odour, peach odour or acidity), some attributes seem to be negative drivers of refreshing sensation such as thickness and sweetness. Both attributes were identified as negative drivers of refreshing sensation in soft beverages. A strawberry milk beverage was perceived as being less refreshing than a carbonated lemon drink (McEwan & Colwill, 1996). Beers with a high thickness and an intense flavour were perceived as poorly refreshing, thirst-quenching and drinkable (Guinard et al., 1998). Authors explained that the negative link between flavour and texture strength and "refreshing/cooling", "thirst-quenching" and "drinkable" is due to a cognitive association between intensity, caloric content and filling sensation. The negative correlation between thickness and refreshing sensation was also reported by Scriven, Gains, Green, and Thomson (1989) who asked 22 consumers about the contexts in which they typically consumed a range of 22 alcoholic beverages. Five perceptual dimensions common to most people, that explained beverage consumption context, were pointed out. One of them opposed "thirst-quenching" *vs.* "not thirst-quenching". Beverages having the highest thirst-quenching potential were beers and lagers as opposed to brandy, Irish cream and port wine that were thicker.

The above mentioned studies explored refreshing sensation in various commercial foods and highlighted the role of trigeminal perception (cold), odour (mint, peach), taste (acid, sweet) and texture (thickness) in refreshing sensation. But the respective roles of each perception have never been investigated simultaneously in a controlled system. The objective of this study is to better understand the respective roles of olfaction, taste, trigeminal and texture perception on refreshing sensation in a gel model system. Therefore we formulated a range of products with a wide sensory diversity by varying the composition in ingredients inducing different perceptions: a mint odorant, a peach odorant, a cooling agent, an organic acid and a thickener.

Several methodologies have been used in the literature to measure the contribution of sensory determinants to complex perceptions: (1) a trained panel for scoring both refreshing intensity of beers and their sensory characteristics (Guinard et al., 1998); (2) a group of consumers for scoring both freshness of apples and their sensory characteristics (Peneau, Hoehn, Roth, Escher, & Nuessli, 2006) and (3) a trained panel for scoring standard sensory attributes and a group of consumers for scoring either refreshing sensation of beers (McEwan & Colwill, 1996) or creaminess in dairy products (Richardson-Harman et al., 2000; Tournier, Martin, Guichard, Issanchou, & Sulmont-Rossé, 2007). The latter methodology was used in the present study. We assumed that combining analytical data (from Quantitative Descriptive Analyses® using a trained panel) and holistic data (refreshing intensity scoring with a group of consumers) would give a characterisation of refreshing sensation based on consumer perception. A refreshing mapping was built similarly to a standard internal preference mapping (Mc Fie & Thomson, 1988) but using refreshing scores instead of liking scores.

2. Materials and methods

2.1. Product formulation and selection of a reduced set of products with a wide range of sensory characteristics

A gel with visco-elastic properties containing fructose (16%) sucrose (32%), dextrose (32%) and water (20%) was used as model for this study. A mint odorant (supplier reference 112606), a peach odorant (supplier reference L-129046), a cooling agent (WS-3), these three additives being provided by Givandan SA (Geneva, Switzerland), citric acid and a Keltrol RD xanthan gum thickener provided by CP Kelco Ltd. (Knowsley, UK) were used to induce olfactory (mint and peach), trigeminal (coldness), taste (acidity) and texture (thickness) perception of different intensities. Two formulation designs were built, one for each odorant, with the four ingredients (odorant, cooling agent, citric acid and thickener) at a low and a high level. For each ingredient, the two concentrations were selected according to the following sensory criteria: the two concentrations for each ingredient clearly induced two discriminable perceptual intensities. As it was key to dissociate cold and olfactory perception, the mint odorant was selected so that it did not induce any cold perception. This was checked through preliminary tasting using a noseclip. Sixteen gel recipes were therefore prepared for the peach and the mint odorant, respectively (Table 1). The most different gels within each odorant type were selected based on two preliminary QDA® conducted independently on each set of products with ten trained subjects and a list of attributes generated by the panel. A total of nine products was kept for the main study (Table 1).

2.2. Sensory characterisation by a trained panel

Twelve external assessors, all women, with an average age of 45, were recruited for the study. None of the assessors participated in the two preliminary QDA®. They were used to participate in sensory panels on different product categories but not on gel products. A 90-min session was dedicated to term generation; three 60-min sessions were conducted for the training on the selected terms and the tasting procedure. Ten attributes were selected (overall odour, coldness, overall flavour, acidity, sweetness, bitterness, salivating, thickness, astringency, coldness persistency) following the term generation and selection phases, performed according to NF ISO 11035 standard (1995). Olfactory attributes were not specific to the flavouring type but were related to the overall perceived intensity (overall odour and overall flavour) to avoid a product clustering opposing peach and mint gels. The role of these two