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An exploratory study of sensory attributes and consumer traits underlying liking for and perceptions of freshness for ready to eat mixed salad leaves in Italy

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ABSTRACT

The role of sensory attributes and storage time information in driving liking for and perceptions of freshness for ready to eat vegetables was investigated in mixed salad leaves for different storage times (0, 3, 7 and 9 days). A modified Repertory Grid Method was used to identify ten attributes describing consumer's perception of sensory properties over storage. Eighty-one consumers rated the overall liking, the intensity of sensory attributes and the level of freshness in salad samples at different storage times. Freshness was evaluated in blind and informed conditions. Furthermore, consumers filled in a *Food Choice Questionnaire* and rated the importance of six attributes known to be important for ready to eat salad choice. The relationships between sensory properties significantly affected by storage time, perceived freshness and liking showed that both liking and freshness were positively related to appearance attributes (green colour, salad assortment and leaf turgidity). The perceived level of freshness, expiry date and appearance were confirmed as the most important attributes for ready to eat salad choice. Two clusters of consumers (Cl1: n = 49; Cl2: n = 32) were identified based on the mean liking rating. The positive effects on health and mood as well as ethical concerns drove food choice more in Cl1 than in Cl2 subjects. No significant effect of storage time was found on liking ratings expressed by Cl1 in blind conditions, while a significant decrease of perceived freshness was observed. On the other hand, results from Cl2 in blind conditions showed a significant decrease of both liking and perceived freshness. Information about storage time significantly affected freshness ratings in Cl1 but did not influence those from Cl2.
Results suggest that collection of sensory data, affective responses and information about the background of subjects is needed to fully investigate the perceptions of freshness from a consumer perspective.

1. Introduction

The connection between dietary habits and human well-being, as well as the importance of fresh fruit and vegetable intake for health, are widely recognized (Hartley et al., 2013). Constraints related to time pressure and lack of convenience are frequently reported as reasons for fresh vegetable and fruit consumption to fall below the recommended daily intake (Ragaert, Verbeke, Devlieghere, & Debevere, 2004). A wide assortment of minimally processed vegetables has been developed over the last decade to address the consumer demand for convenience and encourage consumption for health benefits (Ragaert et al., 2004; Rico, Martín-Diana, Barat, & Barry-Ryan, 2007). Minimally processed vegetables are defined as foods that have been processed to increase their functionality without changing their fresh-like properties (Salunkhe, Bolin, & Reddy, 1991). However, while conventional processing methods extend the shelf-life of vegetables, the minimal processing (consisting of washing, cutting, mixing and packaging), renders these food highly perishable (Rico et al., 2007). Appearance, texture, flavour and the nutritional value of fresh vegetables gradually change during storage due to the physiological activities involved in tissue senescence (Rico et al., 2007). The increasing difference between the original and minimally processed vegetables during storage can be defined as freshness loss (Péneau, Hoehn, Roth, Escher, & Nuessli, 2006).

Consumers consider ready-to-eat vegetables as very perishable thus the perceived level of freshness is the most important motivation both at purchase and consumption (Jung, Padmanabahn, Hong, Lim, & Kim, 2012; Péneau et al., 2006; Ragaert et al., 2004; Vidal, Ares, & Giménez, 2013). Several instrumental techniques are available for measuring physiological ageing and defining product shelf life (Barrett, Beaulier, & Shewfelt, 2010; Barry-Ryan, Martin-Diana, Rico, & Barat, 2007; Butz, Hofmann, & Tauscher, 2005; Di Egidio et al., 2009; Torri, Sinelli, & Limbo, 2010). The results of instrumental tests can be directly related

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to the chemical and physical characteristics of products but, often have little relevance to consumer freshness evaluation (Barrett et al., 2010). Sensory evaluations are often used to describe perceived changes in product properties during storage and the overall level of perceived freshness (Giménez, Ares, & Ares, 2012). Sensory attributes mainly describing appearance and texture are related to the degree of perceived freshness and specifically describe physiological ageing of the product under evaluation (Ares, Gimenez, & Gambaro, 2008; Ares, Martínez, Lareo, & Lema, 2008; Fillion & Kilcast, 2002; Jung et al., 2012; Løkke, Seefeldt, & Edelenbos, 2012; Martinez, Ares, & Lema, 2008; Péneau, Brockhoff, Escher, & Nuessli, 2007; Péneau, Brockhoff, Hoehn, Escher, & Nuessli, 2007; Péneau et al., 2006). Quality and intensity of taste and odour descriptors are also related to the degree of perceived freshness, albeit to a lower extent (Péneau, Linke, Escher, & Nuessli, 2009).

The decay of product sensory properties and the consequent lowering of its acceptability by consumers can occur before the deterioration of nutritional and microbiological characteristics. The sensory shelf-life has been defined as "the storage time when the product reaches a certain predetermined deterioration level, above which it is not saleable" (Giménez et al., 2012). Failure criteria and design methodologies for sensory shelf-life estimation have been extensively reviewed by Giménez et al. (2012). Studies performed on fresh cut vegetables showed that in several cases the shelf life of this product category was severely limited by odour and appearance changes (Ares, Gimenez, & Gambaro, 2008; Ares, Martínez, Lareo, & Lema, 2008; Lareo, Ares, Ferrando, Gambaro, & Soubes, 2009; Li, Brackett, Shewfelt, & Beuchat, 2001; Liu & Li, 2006; Medina, Tudela, Marín, Allende, & Gil, 2012).

Consumer studies have shown that several individual socio-cognitive traits like demographic factors, previous experience, cultural and environmental differences, purchase habits (Bech, Grunert, Bredahl, Juhl, & Poulsen, 2001; Jung et al., 2012; Ostli, Esaiassen, Garitta, Nostvold, & Hough, 2013; Péneau et al., 2009) and product associated information (Cardello & Schutz, 2003; Lund et al., 2006) significantly influence consumer perceptions of food, including the perceived freshness level. In particular, shelf-life labelling and storage time information significantly affect perceptions of freshness and food acceptability by consumers (Ragaert et al., 2004; Wansink & Wright, 2006). Furthermore, consumer acceptance or rejection of products with different storage times can be related to the perception of shelf life hazard (Hough, Langohr, & Gomez, 2003) and to the self-perceived level of expertise in judging food freshness (Ostli et al., 2013). Thus, from the consumer's perspective, freshness has been defined as a meta-descriptor, i.e. it is a property that is the result of integrating many other properties (Løkke et al., 2012).

The main aim of the present work is to explore the underlying sensory attributes of perceptions of freshness for ready to eat mixed salad leaves during the commercial shelf life of the product. Understanding attributes and factors underlying perceptions of freshness for a specific food will improve the comprehension of the consumer purchase-decision process and help producers to better satisfy consumer's requirements and expectations. The effects of information about storage time and of consumer characteristics on both freshness and liking evaluations are assessed.

2. Materials and methods

2.1. Products

Ready to eat mixed salads, widely available on the Italian market (radicchio, endive, rocket, watercress and lettuce, almost in equal proportion) with a shelf life of 9 days, are produced by several industrial plant. One product, packaged in completely clear multilayer plastic bags (125 g per serving) under modified atmosphere (CO_2/N_2; 5% CO_2), was stored at 3 ± 1 °C and presented to consumers for sensory evaluation after 0 (T0), 3 (T3), 7 (T7) and 9 (T9) days of storage.

2.2. Repertory Grid Method

2.2.1. Respondents

Respondents were recruited in Florence area (Tuscany, Italy), having seen or received an invitation to fill in an on-line questionnaire about dietary habits and volunteered, based on their interest and availability. The questionnaire included: demographic (gender, age, educational level), and dietary regimen (regular, vegetarian or vegan) items, indications of responsibility for food purchase and preparation (completely responsible, partially responsible, not at all responsible) and frequency of consumption of ready to eat salads (6-point category scale: 1 = never; 2 = once a month; 3 = two–three times a month; 4 = once a week; 5 = two–three times a week; 6 = two–three times a day).

Twenty-five respondents were recruited (8 males, 17 females; age: 18–53 years) with a self-reported average frequency of consumption of ready to eat salads of two–three times a month. All the respondents were at least partially responsible for food purchase and preparation (twelve were completely responsible). Twenty-four respondents followed a regular diet and one was vegetarian. Written informed consent was obtained from each respondent after the description of the experiment.

2.2.2. Elicitation of descriptors

For the elicitation of descriptors, one-on-one interviews lasting 45–60 min were conducted by a single trained moderator. Sealed packages of sample salads in groups of three (triads) were presented to respondents. Each respondent received four triads (T0, T3 and T7; T9, T0 and T3; T7, T9 and T0; T3, T7 and T9) and thus each respondent received twelve samples in total. In practice, all the experimental samples (four), arranged in all possible triads (four), were presented to each respondent. The triads listed above were presented in a balanced order across respondents.

A modified version of the Kelly's Repertory Grid Method (RGM) was used (Monteleone, Raats, & Mela, 1997; Raats & Shepherd, 1992; Russell & Cox, 2003, 2004; Tarancón, Fiszman, Salvador, & Tárrega, 2013). For each triad, the following instructions were given: "We will now present you three mixed salad samples and want you to indicate which you would like to consume the most, as part of your next meal? Please look at the appearance first, then open the package, smell and taste". After the evaluation of each triad, respondents were asked: "Thinking of appearance, aroma, flavour and texture, which sample would you like to consume most as part of your next meal?" After respondents indicated the sample, they were asked to write down all the reasons they would like to consume the chosen product instead of the others. Then, the interviewer removed the chosen sample from the triad and subjects were asked again: "Thinking of appearance, aroma, flavour and texture of these two remaining samples, which one would you like to consume most as part of your next meal?" After subjects indicated the sample they would like most to consume, they were asked again to write down all the reasons for their choice.

The elicited descriptors were entered into a form with a 100 mm visual analogue scale (VAS) with ends labelled as "weak" on the left side (0 mm) and "strong" on the right side (100 mm) and an intermediate point labelled as "moderate" (50 mm) (Lawless and Heymann, 2010). Respondents then had a break of 15 min.

Respondents were then presented with a new set of the four samples and were asked to evaluate the intensity of their personal descriptors on the VAS. Samples were presented in sealed clear packages identified by a three-digit code. The order of sample presentation was randomized across respondents. After each sample, subjects rinsed their mouths with distilled water for 30 s, had some water for 30 s and finally rinsed their mouths with water for a further 30 s. Evaluations were performed in individual booths under white light. A computerized system (FIZZ Version 2.47B, Biosystèmes, Couternon, France) was used for data recording.