



Towards a multi-dimensional concept of vegetable freshness from the consumer's perspective



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ABSTRACT

A large number of studies has demonstrated health benefits deriving from a high consumption of fruits and vegetables. It is therefore of great importance to understand consumers' expectations about this kind of food as well as to explore the aspects that influence their interpretation of freshness. The objective of this research was to gain insight into consumers' conceptualization of vegetables freshness, by analyzing the underlying variables that summarize various consumers' beliefs and expectations on sensory and non-sensory attributes of vegetables. The study considered different stages in which consumers could interpret freshness of three vegetables (tomato, wild rocket, and spinach): at purchase and consumption, with none or some degree of processing and transformation between harvesting and final use. The overall category of 'fruit and vegetables' was included in order to examine beliefs towards freshness, without any reference to a specific product. According to the consumers' opinions, sensory properties were confirmed as the most important indicators of freshness for all products. However, interesting cues relating to non-sensory components have come to light. Particularly, this study provided evidence that freshness is no longer an attribute commonly associated with raw products. Also minimally processed vegetables can be perceived as fresh, on condition that consumers can easily visually assess the integrity and color of the product inside. Frozen spinach is considered as fresh, as long as the whole leaves have been frozen soon after harvest. These findings may contribute to strategic marketing decisions by vegetables and packaging industries, and be important for policy makers in designing public health interventions.

1. Introduction

Food choice is subject to a very complex network of interrelated factors and the perceived freshness of foods seems to be one of those. From the consumers' point of view, freshness is an important attribute of the perceived quality of foods (Farruggia, Crescimanno, Galati, & Tinervia, 2016; Tsiros & Heilman, 2005; Acebrón & Dopico, 2000).

Much of consumer literature on freshness of foods focuses on fruits and vegetables (Jung, Padmanabhan, Hong, Lim, & Kim, 2012; Péneau, Hoehn, Roth, Escher, & Nuessli, 2006; Péneau, Linke, Escher, & Nuessli, 2009; Ragaert, Verbeke, Devlieghere, & Debevere, 2004). A large number of studies demonstrated health benefits from a high consumption of vegetables and fruits, thanks to their protective functions (Hartley et al., 2013; Woodside, Young, & McKinley, 2013). Despite this evidence and public health campaigns to increase their intake, consumption of vegetables and fruits is still below the recommended daily intakes in many countries (Rekhy & McConchie, 2014; USDA, 2016). Consequently, new strategies are needed to make the interventions designed to increase fruit and vegetables intakes more effective

(Farragher, Wang, & Worsley, 2016; Rekhy & McConchie, 2014). Nowadays, the lack of time makes preparation and cooking of fresh vegetables one of the barriers to the growth of their consumption (Farragher et al., 2016; Pollard, Kirk, & Cade, 2002). It would be worthwhile investigating what consumers think about fruits and vegetables freshness taking into account also those products that are processed to meet their needs about time pressure.

From a consumer's perspective, the definition of freshness is a complex matter that involves a plurality of sensory and non-sensory attributes and elements (Cardello, Schutz, Cadwallader, & Weenen, 2003; Dinnella, Torri, Caporale, & Monteleone, 2014; Heenan, Hamid, Dufour, Harvey, & Delahunty, 2009; Jung et al., 2012; Péneau, Brockhoff, Escher, & Nuessli, 2007; Péneau et al., 2006, 2009; Zhang, Lusk, Miroso, & Oey, 2016). Only a limited number of authors investigated the relevance of sensory attributes in influencing the consumers' perception of fruits and vegetable freshness and there are even fewer authors exploring the importance of non-sensory attributes.

A survey (Péneau et al., 2006) carried out on a large sample of consumers, aimed at investigating the contribution of sensory and non-

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sensory attributes (selected from literature) to the concept of freshness, indicated that taste, crispness and juiciness were the most relevant characteristics for consumer's evaluation of apples freshness, whereas other aspects such as appearance, storage time, nutritional value and organic were of lesser importance.

Another consumer research study, using a direct elicitation by means of an open-ended questionnaire for investigating consumers' description of freshness in relation to 'fruit', 'vegetables' and 'fruits and vegetables' (Péneau et al., 2009), confirmed that the contribution of sensory attributes to the concept of freshness was stronger than the non-sensory ones. Appearance and texture attributes were indeed the most cited terms, followed by phrases or terms expressing a level of closeness to the original product, in terms of time, distance and processing.

Sensory experiments on strawberries and carrots varying in time and condition of storage (Péneau et al., 2007) have shown that a number of indicators of the physiological ageing of strawberries and carrots, generated from an expert panel, related to the degree of perceived freshness. Appearance and texture attributes were dominating aspects. In particular, shininess, juiciness, and flavor were positively related to perceived freshness of strawberries, whereas shininess, crispness and firmness were linked to perceived freshness of carrots.

Other authors (Dinnella et al., 2014), studied the relationships between sensory properties (appearance, aroma, flavor and texture) and perception of freshness for ready-to-eat mixed salads leaves. Consumers rated the overall liking, the intensity of sensory attributes and the level of freshness in salad samples at different storage times. The evaluation of freshness was positively linked to appearance attributes (green color, salad assortment and leaf turgidity) and negatively associated with putrid off-odor.

It is recognized that situational factors, such as the moment of purchase and consumption, may contribute differently to the consumer perception of food quality and to the relevance of attributes that influence food choice (Grunert, Bech-Larsen, & Bredahl, 2000; Piqueras-Fiszman & Jaeger, 2015; Ragaert et al., 2004). Besides, freshness of minimally processed vegetables was found to be equally important during purchasing and at consumption moment (Ragaert et al., 2004). To our knowledge, no studies explored the consumers' idea of fruits and vegetables freshness, at purchase versus consumption moment.

Although fruits and vegetables are often presented as one category of products, they do not represent a homogeneous food group. It is also likely that consumers may bear in mind different food components when considering fruits and vegetables as general category. Consequently, their opinion on freshness could vary among different fruits and vegetables.

Considering all this, the general objective of this study was to gain insights into consumers' interpretation of freshness by examining a composite of consumer beliefs and expectations on sensory and non-sensory attributes describing fruits and vegetables freshness. This paper will focus on freshness of fruits and vegetables as general category and then specifically on that of vegetables that generally require a greater amount of time of preparation than fruits, this being one of the perceived barriers to higher consumption. Vegetables products were selected according to their use and availability on Italian markets, with none or some degree of processing and transformation. This in order to generate variation in product attributes and explore more in-depth the idea of vegetables freshness by consumers.

In light of all this, the overall aim of this study was to gain insights in the consumers' interpretation of vegetables freshness by examining the concept of freshness as underlying variables summarizing a composite of consumer beliefs and expectations. To this end, the paper had the following three objectives:

- 1) to explore and confirm underlying factor structures of beliefs associated with freshness of, respectively, 'fruits and vegetables' as one category, and of three specific vegetables (tomatoes, wild rocket, spinach), with particular reference to different stages in which the

freshness could be interpreted by consumers, at purchase and consumption moment;

- 2) to examine a broader concept of freshness for, respectively, 'fruits and vegetables', tomatoes, wild rocket and spinach;
- 3) to explore a single higher-level of freshness for the 'vegetable' category, accounting for the inter-correlations among the first-order factors from all the three products (tomatoes, wild rockets and spinach).

2. Materials and methods

2.1. Respondents

Data collection took place in the autumn of 2014 from a sample of 1002 subjects representative of Italian consumers for three age classes (18–30, 31–64, ≥ 65) and for two resident areas, based on urbanization of living environment (rural and urban). The sample had equal quotas for men versus women, and included those solely or jointly responsible for the family's food shopping. Subjects who were not consumers of tomato, wild rocket and spinach were excluded from the study. A self-completion questionnaire was delivered to each participant. Subsequently, respondents were contacted by phone to arrange an appointment to pick the completed questionnaire up.

2.2. Products

Three vegetables products commonly consumed by Italians (Leclercq et al., 2008), such as tomato (*as fruit vegetable*), wild rocket and spinach (*as leafy vegetable*) were selected according to their use and availability on Italian markets with none or some degree of processing and transformation. Wild rocket is commonly consumed raw in salad and available in markets as raw and minimally processed product. Spinach is generally consumed either raw in salad or cooked in side dish, and sold as raw, minimally processed, and frozen product. Tomato is consumed either as side dish or as sauce (tomato base for other dishes) and is available in markets in different processed forms including raw, pre-packaged, and canned. The overall category of 'fruit and vegetables' was included in the present study to examine beliefs towards freshness of that broader group of products, without doing any reference to specific products.

2.3. Questionnaire

The questionnaire was structured in four sections aimed at collecting information on consumer's interpretation of vegetable freshness, vegetable quality, food-related lifestyles and food habits. A fifth section provided demographic information. Due to the aim of the present research, only the first section of the questionnaire will be described in detail below.

The first section included beliefs on freshness of vegetables identified from a qualitative investigation previously carried out (Saba, Moneta, Peperario, Scalvedi, & Sinesio, 2016), in which participants in three focus groups ($n = 30$) were encouraged to spontaneously express their opinions about freshness of 'fruits and vegetables', as general category, and specific vegetables, such as tomato, wild rocket and spinach. Within focus groups, participants were shown a selection of specific fruits and vegetables products present on the market, covering different forms of processing (raw, minimally processed, frozen). For each specific vegetable, the moment of commodity purchase and, at a later time, the moment of preparation and consumption were evoked to make the participants able to come spontaneously to their mind thoughts and opinions towards its freshness. Finally, 72 opinions (see Appendix 1) deriving from the content analysis of topics brought up by the focus groups were included in the present study. Then, a first set of questions that included 15 opinions towards the freshness of the overall category of 'fruits and vegetables' was prefaced with: 'Consider the

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