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Visually suboptimal bananas: How ripeness affects consumer expectation and perception

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ABSTRACT

One reason for the significant amount of food that is wasted in developed countries is that consumers often expect visually suboptimal food as being less palatable. Using bananas as example, the objective of this study was to determine how appearance affects consumer overall liking, the rating of sensory attributes, purchase intention, and the intended use of bananas. The ripeness degree (RD) of the samples was adjusted to RD 5 (control) and RD 7 (more ripened, visually suboptimal). After preliminary experiments, a total of 233 participants were asked to judge their satisfaction with the intensity of sensory attributes that referred to flavor, taste, and texture using just-about-right scales. Subjects who received peeled samples were asked after tasting, whereas subjects who received unpeeled bananas judged expectation and, after peeling and tasting, perception. Expected overall liking and purchase intention were significantly lower for RD 7 bananas. Purchase intention was still significantly different between RD 5 and RD 7 after tasting, whereas no difference in overall liking was observed. Significant differences between RD 5 and RD 7 were observed when asking participants for their intended use of the bananas. Concerning the sensory attributes, penalty analysis revealed that only the firmness of the RD 7 bananas was still not just-about-right after tasting. The importance that consumers attribute to the shelf-life of food had a pronounced impact on purchase intention of bananas with different ripeness degree. In the case of suboptimal bananas, the results demonstrate a positive relationship between the sensory perception and overall liking and purchase intention. Convincing consumers that visually suboptimal food is still tasty is of high relevance for recommending different ways of communication.

1. Introduction

In developing countries, the majority of food waste stems from insufficient conditions of storage, processing, or transportation whereas, in developed countries, it is mainly generated by the consumer (FAO, 2011; Parfitt, Barthel, & Macnaughton, 2010). Households account for approximately two thirds of the waste in the food supply chain. This equals 95 kg per head and year in Europe and 82 kg per head and year in Germany, with almost 50% being fruits and vegetables (FAO, 2011; Kranert et al., 2012). Consumers contribute to food waste (a) by selectively leaving items on supermarket shelves when, e.g., fruits show bruises, or when the best-before date is too close; (b) by discarding during consumption when the food does not meet sensory expectations, or when unexpected ingredients are detected; (c) when household stock is incorrectly estimated; (d) when knowledge on palatability is missing; and (e) because food is not valued due to the low price level. Generally speaking, consumers generate food waste either in the store when they decide what to buy, and in the household when they decide what to consume (Aschemann-Witzel, de Hooge, & Normann, 2016; Aschemann-Witzel, de Hooge, Amani, Bech-Larsen, & Oostindjer, 2015; Stefan, van Herpen, Tudoran, & Lähteenmäki, 2013). Food waste at the consumer level has a particularly negative environmental impact, as all the resources for production, transport, and preparation are wasted (Williams & Wikström, 2011).

Studies providing insight into willingness to purchase or to consume suboptimal products are scarce. Aschemann-Witzel et al. (2015) stated that "We call food products that are wasted at the consumer level even though they are edible "suboptimal foods", defined as foods that consumers perceive as relatively undesirable as compared to otherwise similar foods because they either: (1) are

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close to, at or beyond the best-before date; or (2) deviate (visually or in other sensory perception) from what is regarded as optimal (usually equal to what is perceived as "normal")". There are only a few studies which investigate that consumers act differently towards suboptimal foods when they need to make a purchase decision in a supermarket, compared to when they need to make a consumption decision at home (de Hooge et al., 2017). The study of de Hooge et al. (2017), for instance, shows that consumer preferences for suboptimal foods differ depending on whether the consumer is in a supermarket or at home, and depending on the type of sub-optimality. In a supermarket, consumers do not want to buy too long ripened foods at regular price. In contrast, when consumers detect too long ripened food at home, they may want to use it to avoid losing money (as the food was already bought).

The first contact between consumer and food is usually through the visual impression of intrinsic or extrinsic product attributes. Many studies investigated influences of intrinsic or extrinsic product attributes on food liking, food intake, food consumption, purchase intention, or sensory expectations (e.g., Carrillo, Varela, & Fiszman, 2012; Mai, Symmank, & Seeberg-Elverfeldt, 2016; Zellner, Loss, Zearfoss, & Remolina, 2014). However, for both intrinsic and extrinsic attributes only a few studies examined consumer evaluation of visually suboptimal foods in the light of sustainability. For instance, White, Lin, Dahl, and Ritchie (2015) demonstrated that consumers avoid products with superficial packaging damage as this implies contamination and generates safety concerns. Loebnitz and Grunert (2015) focused on shape abnormalities of apples, lemons, carrots and eggplants as intrinsic cue to examine purchase intention, and Bunn, Feenstra, Lynch, and Sommer (1990) reported on low acceptance of imperfect oranges. Based on the assumption that consumers associate food abnormalities with low quality, it is common practice to remove foods that do not follow an appearance standard (e.g. shape, color, size) from shelves in retail outlets. In turn, due to the availability of regular low price alternatives, retailers do not consider putting suboptimal products on their shelves (Aschemann-Witzel et al., 2016).

Recent research called to examine how sensory impressions based on criteria other than shape influence buying intention (Loebnitz & Grunert, 2015). In fruits and vegetables, for example, color serves as indicator for the progress of ripening or even decay. Hence, color as part of the "natural packaging" of a food gives a first visual impression that usually generates expectations of flavor, texture, or overall quality (Bello Acebrón & Calvo Dopico, 2000; Wei, Ou, Luo, & Hutchings, 2012). A prominent example is bananas which, in the context of ripening, have been studied with respect to peel color, texture, and biochemical changes (Bugaud et al., 2013; Facundo, Gurak, Mercadante, Lajolo, & Cordenunsi, 2015; Gomes, Vieira, & Leta, 2013; Jaiswal et al., 2012; Salvador, Sanz, & Fiszman, 2007). More recent research focused on the sensory description of bananas (Bugaud et al., 2011; Nunes, Yagiz, & Emond, 2013; Tobin, Moane, & Larkin, 2013). To the best of our knowledge, only one study analyzed bananas in context with food waste, and determined what was called the banana waste critical point (Nannyonga, Bakalis, Andrews, & Gkatzionis, 2016). Bananas can be classified on the basis of the peel color into seven ripeness degrees, usually assigned by using a standardized color chart: (1) totally green; (2) green with yellow traces; (3) more green than yellow; (4) more yellow than green; (5) yellow with green edges; (6) totally yellow; and (7) yellow with brown spots (Von Loesecke, 1950).

With regard to the consumers' food waste behavior, an important motivation for discarding fruits and vegetables is the presence of visual defects. Using bananas as model, the objective of the study was to show how visual exposure influences expectation and perception of the food. Depending on whether a visually suboptimal or a regular product is inspected, we analyze overall liking, the rating of sensory attributes, purchase intention, and the intended use of bananas. The current research will provide insights into both the supermarket setting (by revealing overall liking and purchase intention of unpeeled bananas based on visual exposure only), and the home situation. The home situation is considered in two ways: First, consumers generate expectations of the unpeeled banana with different degrees of ripeness, depending on the duration of home storage. Subsequently, consumers evaluate overall liking and re-purchase intention based on sensory perception of the (self-)peeled banana. As consumer general food waste behavior has been shown to depend on gender (Koivupuro et al., 2012), this study also aims at analyzing differences in the responses between males and females.

2. Material and methods

2.1. Recruitment of participants

To recruit participants, email newsletters with the slogan 'Taste it? Your senses will help us!' were sent to student representatives of Technische Universität Dresden with a request to distribute it in their respective channels, and announcements were placed in cafeterias and bulletin boards across the campus. Prospective participants were asked to register on a web page. Individuals from this pool were contacted, and finally 233 participants took part in the study (140 male and 93 female, mean age 22.2 ± 3.1 years). All participants received written information about the study before giving their informed consent. However, the participants were not informed beforehand which particular product they were about to taste, and no information on the study aim was provided.

2.2. Stimuli material: bananas

For preliminary experiments, we bought bananas of ripeness degree (RD) 3–4 from a regional fruits and vegetables wholesaler (Landgard, Dresden, Germany). According to the wholesaler, this is the ripeness degree in which the bananas are usually sold to the supermarkets. The bananas were stored at 20 °C (Quevedo, Mendoza, Aguilera, Chanona, & Gutiérrez-López, 2008) in an environmental chamber (IPP 55, Memmert GmbH & Co. KG, Schwabach, Germany). Banana peel color was compared daily with the color chart by the author to record banana ripeness. After three days of storage the bananas reached RD 5 (yellow with green edges) and after seven days the first brown spots were visible that is typical for RD 7. Bananas of RD 7 are no longer sold in the supermarket. For the main study, the bananas were purchased some time in advance to ensure that, on the day of investigation, samples with RD 5 and RD 7 were available (Fig. 1).

2.3. Experiment design

Each of the 233 participants contributing to the study was randomly assigned to one of four test conditions. Fig. 2 shows that group 1 (G 1) and group 2 (G 2) subjects received one peeled banana of either RD 5 or RD 7, to immediately rate overall liking, the perception of sensory attributes during tasting, purchase intention, and intended use of the banana (blind condition). Group 3 (G 3) and group 4 (G 4) subjects received an unpeeled banana of either RD 5 or RD 7. In a first step, they were encouraged to rate overall liking, the expected satisfaction with the intensity of sensory attributes, purchase intention, and intended use of the banana based on visual impression. In a second step, the participants had to peel and taste the banana, and to rate again overall liking, the perceived satisfaction with the intensity of sensory attributes, purchase intention,