Food Research International 100 (2017) 254–259

Contents lists available at ScienceDirect

Food Research International

journal homepage: www.elsevier.com/locate/foodres

Consumer perception of salt-reduced breads: Comparison of single and two-bites evaluation

Lucía Antúnez*, Ana Giménez, Florencia Alcaire, Leticia Vidal, Gastón Ares

Sensometrics & Consumer Science, Instituto Polo Tecnológico de Pando, Facultad de Química, Universidad de la República, By Pass de Rutas 8 y 101 s/n, CP. 91000 Pando, Canelones, Uruguay

ARTICLE INFO

Keywords:
Salt reduced bread
Consumer research
Multiple bite
CATA questions
Hedonic perception

ABSTRACT

Salt-reduction in processed products has been proposed as a high-impact intervention for reducing the sodium intake at population level. A major limitation for this approach is its potential negative impact on the sensory characteristics of products. The current practice in sensory and consumer science involves single sip/bite evaluations, which may not properly reflect the sensory experience that occurs during product consumption. In this context, the aim of the present work was to compare single and two bite evaluations of consumer sensory and hedonic perception of salt-reduced breads. Five studies with a total of 499 consumers were carried out, in which overall-liking scores of five salt-reduced bread samples were collected after the first and the second bite evaluation. In one of the studies consumers also answered a CATA (check-all-that-apply) question after the first and the second bite. Neither bite nor the interaction between samples and bite had a significant effect on hedonic scores. However, when hedonic scores were analysed separately for each bite, the overall liking scores from the second bite evaluation better reflected differences among samples according to their salt content in two of the five studies. The sensory characterization of the samples did not largely vary between the first and the second bite. Results suggest that consumers' perception of salt reduced bread samples did not largely vary between a single and a two bites evaluation. Further research is warranted in this regard, in particular considering more complex products.

1. Introduction

The burden of non-communicable diseases (NCDs) over the last decade has raised serious global public health concerns, being the major cause of mortality and morbidity all over the word (World Health Organization, 2014). In terms of attributable deaths, high blood pressure has been identified to be the leading metabolic risk factor for the prevalence of NCDs, in particular of cardiovascular diseases. One of the factors that is most closely related to the growing prevalence of high blood pressure is excessive sodium intake (Elliott et al., 1996). In this sense, even relatively small changes in population dietary sodium intake are expected to have a major impact on global health (He & MacGregor, 2009; World Health Organization, 2007). For this reason, reducing sodium intake at population level has been proposed as a high-impact intervention to prevent and control the prevalence of high blood pressure (Campbell, Johnson, & Campbell, 2012).

In developed countries, processed foods have been identified as the main source of dietary sodium, accounting for 75%–80% of the total sodium intake (Appel & Anderson, 2010; Campbell, Johnson, and Campbell, 2012; Grimes, Campbell, Riddell, & Nowson, 2011). Hence, the reformulation of processed foods through a lower salt content has been proposed as a cost-effective strategy to reduce the sodium intake at the population level (Downs et al., 2015). For this purpose, either voluntary or mandatory targets for salt reduction in different food products categories are being established to encourage the food industry to engage in reformulation strategies (Downs et al., 2015; Legowski and Legetic, 2011).

Given the widespread consumption of bread and its major contribution to the daily sodium intake, this product has been established as a target product category for salt reduction in many countries (Girgis et al., 2003; Belz, Ryan, & Arendt, 2012, Kloss et al., 2015). Several studies have already explored the impact of sodium reduction in bread production (Antúnez, Giménez, & Ares, 2016; Beauchamp, Bertino, & Moran, 1982; La Croix et al., 2014; Lynch, Dal Bello, Sheehan, Cashman, & Arendt, 2009; Pflaum, Konitzer, Hofmann, & Koehler, 2013; Rødbotten et al., 2015; Spina et al., 2015). These studies have shown that despite of being technologically feasible, salt reduction has a negative impact on the flavour characteristics of

* Corresponding author.
E-mail address: lantunez@fq.edu.uy (L. Antúnez).

http://dx.doi.org/10.1016/j.foodres.2017.07.014
Received 2 May 2017; Received in revised form 3 July 2017; Accepted 4 July 2017
Available online 05 July 2017
0963-9969/

bread and, consequently on consumer's preferences. Therefore, a major limitation to salt reduction in bread and other processsed foods is its potential negative impact on the sensory characteristics of the product. Understanding the influence of salt reduction on consumers' perception is a key aspect for the design and implementation of salt-reduction strategies.

Current practice in sensory and consumer science involves single sip/bite evaluations. However, eating is a dynamic process that generally involves multiple ingestions of the food product (Appelqvist, Poelman, Cochet-Broch, & Delahunty, 2016). Thus, the evaluation of a single bite/sip may not properly reflect the sensory experience that occurs during product consumption, especially when considering complex products or samples with small differences among them (Appelqvist et al., 2016; Köster, 2003; Rocha-Parra, García-Burgos, Munsch, Chirife, & Zamora, 2016; Stein, Nagai, Nakagawa, & Beauchamp, 2003; Zorn, Alcaire, Vidal, Giménez, & Ares, 2014). According to Köster (2003) repeated food ingestions may modify food perception as a consequence of adaptation processes. In this sense, several studies have suggested that single hedonic evaluations may not properly predict the future liking (Köster, 2003). In addition, it has been reported that small differences among products only become noticeable after repeated food ingestions (Köster, 2009; Köster, Couronne, Léon, Lévy, & Marcelino, 2002; Stein et al., 2003; Zandstra, Weegels, Van Spronsen, & Klerk, 2004). Therefore, single bite evaluations may not accurately reflect how consumers perceive salt-reduced products in real-life consumption situations, which could lead to innacurate recommendations for salt-reduction.

To the authors knowledge, few studies have considered multiple sip/bite evaluations when assessing the sensory and hedonic perception of food products. Zorn et al. (2014) used an extension of the Temporal Dominance of Sensations (TDS) method, that involves multiple sip/bite TDS evaluations (Vandeputte, Romans, Pineau, & Lenfant, 2011), to assess the dynamic sensory profile of orange juices samples. This approach has also been used by Schlich, Urbano, and Visalli (2013) on chocolate samples. More recently Rocha-Parra et al. (2016) proposed a multiple bite method to evaluate the temporal changes in consumers overall liking of a new healthy beverage and Appelqvist et al. (2016) used a multiple ingestion approach to assess the sensory characteristics of different oil in water emulsions.

In this context, the aim of the present work was to explore the effect of two bite evaluations (vs. a single bite evaluation) on consumer sensory and hedonic perception of food products, using salt reduced bread as focal product.

2. Materials and methods

Five consumer studies were carried out to compare the evaluation of the first and second bite on consumers' hedonic perception of salt-reduced breads. In addition, in Study 1 the effect of multi-bite evaluation on product sensory characterizations was explored by asking consumers to answer a CATA question after having tried the first and the second bite. Details regarding each of the studies are presented in Table 1.

2.1. Participants

The number of participants in each of the studies ranged from 99 to 101; their age and gender characteristics are summarized in Table 1. Participants from Studies 2 and 4 belonged to the same sample population. They were randomly divided into two groups and were assigned to either Study 2 or Study 4. The same occurred in relation to Studies 3 and 5. Participants were recruited from the data base of the Sensometrics & Consumer Science research group of Universidad de la República (Uruguay), based on their bread consumption and willingness to take part in the study. All participants signed an informed consent form and received a small gift for their participation.

Table 1
Overview of the studies used to compare single and multiple (two) bite evaluations.

Study ID	Number of consumers	Age range (average age)	Gender (%)	Product category	Number of samples
1	99	18–66 (average: 30.0)	F: 55% M: 45%	Pan bread	5
2	101	18–60 (average: 23.9)	F: 43% M: 57%	French bread	5
3	99	18–67 (average: 27.7)	F: 71% M: 29%	French bread	5
4	99	18–54 (average: 24.3)	F: 66% M: 34%	French bread with Danbo cheese[a]	5
5	100	18–67 (average: 28.2)	F: 73% M: 27%	French bread samples presented with information about percentage of salt reduction	5

The following abbreviations were used to indicate consumers' gender: F for female and M for male.

[a] Danbo cheese is a semi-soft, cow's milk cheese that is usually consumed with bread in Uruguay. The Danbo cheese used in the present study was obtained from the local marketplace. Its sodium content was 543 mg/100 g of cheese.

2.2. Samples

Bread samples with different salt content were considered. The salt concentrations used for bread formulation (2.00%, 1.80%, 1.61%, 1.38% and 1.25% salt) were defined according to gradual salt reduction steps established in a previous study involving the same product category (Antúnez et al., 2016). Two types of bread were considered: pan bread and French bread.

Study 1 involved pan breads samples. All samples were produced using 58% Uruguayan commercial wheat flour (Molino Americano S.A., Montevideo, Uruguay), 37% tap water, 2.4% sugar (Alcoholes del Uruguay S.A., Bella Unión, Uruguay), 1.6% high oleic sunflower oil (Compañía Oleaginosa Uruguaya S.A., Montevideo, Uruguay), 1% of powered yeast (Fleischmann, Argentina) and salt − 2.0% to 1.25% salt/kg flour (Antil S.A., Montevideo, Uruguay). The breads were prepared in a bread-making machine (Phillips® model HD9015/30) one day prior to testing and were stored in plastic bags overnight. The morning of the test, breads were cut in 10 mm slices and the crust was removed. Each assessor received two pieces of bread, corresponding to approximately 5 g each.

On the other hand, studies 2–5 involved French bread samples that were specially produced for the purpose of the study by a local baking company. Bread samples were cut in 10 mm slices immediately before the test. Each assessor received two bread slices, corresponding to approximately 5 g each. In Studies 2 and 3, consumers evaluated the salt reduced French breads. In Study 4 consumers received the same French bread samples with a slice of Danbo cheese, whereas in Study 5 samples were presented with information about the percentage of salt-reduction.

Samples were served on white plastic plates, coded using three-digit numbers, and were presented in a monadic sequence following an experimental design balanced for order and carry-over effects (Williams' Latin Square).

2.3. Single and two bite evaluations for assessing consumer hedonic and sensory perception of bread samples

In Study 1, consumers were asked to try a first bite of the sample, to