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## Oral comfort: A new concept to understand elderly people's expectations in terms of food sensory characteristics

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## ABSTRACT

In the elderly population, ageing frequently impacts on the different aspects of oral physiology that play a key role in eating behavior. In the context of an aging population, it is crucial to develop a food supply tailored for the elderly people in order to prevent the onset of malnutrition. To meet this challenge, we looked for the concept of "oral comfort" when eating a food. The present study aimed at i) exploring the concept of oral comfort when eating according to elderly people in order to develop a questionnaire to evaluate the oral comfort when eating a food and ii) asking elderly people to evaluate various meat and cereal products using this questionnaire. Results of focus groups highlighted that oral comfort when eating a food is a multi-dimensional concept which includes dimensions related to food oral processing (ability to form and swallow food bolus), food sensory properties (texture and taste) and to a lesser extent pain sensations. Furthermore, the oral comfort questionnaire developed in the present study enabled a discrimination of products and highlighted the fact that some products supposed to fit with elderly people capacities and needs were not rated as the most comfortable foods by the elderly people. The concept of oral comfort when eating a food should be taken into account by those who are willing to design food products tailored to the elderly population. The questionnaire could be an interesting tool to assess oral comfort when eating a food in the elderly population.

### 1. Introduction

In the elderly population, the cumulative effects of physiological ageing, diseases and drugs frequently impact on the different aspects of oral physiology that play a key role in eating behavior (for a review, see Mioche, Bourdiol, & Peyron, 2004). First, ageing often goes along with a reduced strength in jaw muscles (Fontijn-Tekamp, van der Bilt, Abbink, & Bosman, 2004) or with tooth loss (Ikebe et al., 2012), which in turn alters masticatory ability (Mioche, Bourdiol, Monier, & Martin, 2002). According to Steele, Ayatollahi, Walls, and Murray (1997), the conservation of at least 21 well distributed teeth is necessary to maintain a good masticatory function (see also Kohyama, Mioche, & Bourdiol, 2003). Wearing prosthesis may restore the masticatory function, which remains, however, less efficient compared to natural dentition (Bessadet, Nicolas, Sochat, Hennequin, & Veyrone, 2013; Fucile et al., 1998; Veyrone & Mioche, 2000). Second, ageing may often be accompanied by a decrease in salivary flow (Vandenberghe-Descamps et al., 2016) or changes in salivary composition (Vissink, Spijkervet, & Van Nieuw Amerongen, 1996). As the first digestive fluid in contact with food, saliva is a key factor assisting the

oral processing of food, whereby food is transformed into a bolus to be swallowed. During the mastication process, the lubrication function of saliva allows moistening of food and supports the creation of a bolus (Prinz, & Lucas, 1997). Furthermore, some food components are released from the food matrix and dissolved in saliva, where they can be influenced by the presence of salivary components such as salivary enzymes that begin the process of food digestion (i.e. alpha-amylase) or metabolize flavor compounds (i.e., esterases, glycosidases) (Buettner, 2002a, 2002b). Consequently, a decrease in salivary flow or change in saliva composition may have an impact on texture and taste perception (Engelen et al., 2007; Neyraud, 2014). Third, swallowing disorders such as inaccurate initial insertion and foodstuff control, drooling and rapid movements of the tongue as well as delayed swallowing response may also appear with age (Ekberg & Feinberg, 1991; Britton, 2016). According to Ney, Weiss, Kind, and Robbins (2009), presbyphagia corresponds to a moderate impairment of swallowing function induced by a decrease in mastication and salivation efficiency which in turn compromise the formation of a food bolus easy to swallow. Severe swallowing disorder is referred to dysphagia, which may result from an aggravation of presbyphagia (Ney et al., 2009) or from a stroke or a

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neurological disease (Britton, 2016). Dysphagia increases the risk for foods or liquids entering the airway, and thus the risk for pulmonary complications (Marik & Kaplan, 2003) or even choking and mortality (Sharma, Fletcher, Vassallo, & Ross, 2001). Finally, elderly people may suffer from dry mouth or xerostomia, gum disease, mycosis which may induce uneasiness or even pain during food consumption. These oral sensorial complaints often result from drug intake and polypharmacy (Nagler & Hershkovich, 2005). For instance, Sreebny and Schwartz (1997) reported 42 xerogenic drugs categories among which some are frequently prescribed to the elderly (e.g., antihypertensives, anti-arrhythmic medications, psychotropics agents).

Several studies have demonstrated a negative impact of oral disorders on food intake. In particular, a negative relationship between masticatory ability and/or dental status (e.g. number of teeth, number of occlusal contact, denture fitting) on the intake of fruits and vegetable (see Tada & Miura, 2014, for a review), meat (Marcenes, Steele, Sheiham, & Walls, 2003; Savoca et al., 2010), fish (Kim et al., 2007) and nuts (Kimura et al., 2013; Marcenes et al., 2003) was observed. For instance, in Kimura et al. (2013), low chewing abilities evaluated by color-changeable gum was associated with lower intake of vegetables, beans and nuts. Savoca et al. (2010) observed lower fruit, meat and beans intake in older adults with severe tooth loss (0–10 teeth remaining) compared to those with 11+ teeth after adjusting for age, gender, ethnicity, economic status and dental insurance. Only a few studies considered the impact of salivation on food intake (see Muñoz-González et al. (in press) for a review). Actually, Iwasaki et al. (2016) observed lower vegetable and fish intake in older adults with low salivary flow (< 0.5 mL/min) compared to those with high salivary flow. Obviously, these changes in food intake go along with changes in nutrient intake (Van Lancker et al., 2012; Tada & Miura, 2014), which in turn can induce weight loss, sarcopenia, and even malnutrition (Chen, Schilling, & Lyder, 2001; Keller, 1993).

While the impact of oral health on food intake in the elderly has been largely reported in the literature, the impact of oral health on the difficulties encountered by the elderly when eating is less explored. Furthermore, most of the few studies that have explored eating difficulties in the elderly have targeted only one dimension, usually chewing difficulties (e.g., Fontijn-Tekamp et al., 2000; Hsu et al., 2014; Takata et al., 2008). Some have targeted two dimensions (e.g., chewing difficulties and pain sensations in Brennan, Spencer, & Roberts-Thomson, 2008), but to the best of our knowledge, none have targeted all the difficulties liable to be encountered by the elderly when eating a food. Moreover, former studies used either a general question (e.g., “Have you found it uncomfortable to eat any foods because of problems with your teeth or mouth?” Silva, Demarco, & Feldens, 2015) or a question related to a specific food category (e.g., “boiled vegetables” or “firm foods such as steak or dried apricots” in Brennan et al., 2008), but as far as we know, none asked questions during the actual consumption of a food. However, it is worth exploring more in detail which difficulties are encountered by the elderly in an eating situation, both to better understand the impact of oral health on food intake (namely, to better understand which difficulties lead an older individual to avoid one food or another), and consequently to develop a food supply tailored to the oral capacities of the elderly people. To meet this challenge, we looked for the concept of “oral comfort” when eating a food. By “oral comfort”, we mean the “oral sensations” experienced by the elderly people when eating a food, which may range from a negative side (e.g. discomfort, pain) to a positive side (e.g. easiness, pleasure). In the elderly population, it could be hypothesized that these oral sensations influence food choices as well as eating pleasure, appetite and willingness to eat, which in turn may impact dietary variety and food intake. Consequently, oral comfort might be an essential concept to evaluate the acceptability of food products by an elderly population, and thus a key concept to develop foods for the elderly people that meet their oral capacities, namely foods that are associated with positive oral sensations such as easiness to eat and eating pleasure.

In the literature, Witter, De Haan, Kayser, and Van Rossum (1994) associated “oral comfort” with the absence of pain in the mouth, satisfaction toward masticatory ability and aesthetic, and for denture wearers, the absence of complaints regarding their denture. However, this definition of “oral comfort” is more related to “dental comfort” than to the “oral sensations” perceived when eating a food. In food area, some authors outlined the concept of “comfort food”, which refers to palatable foods that are consumed to meet physiological needs (i.e., some foods can have addictive qualities) or psychological needs related to factors such as social context or social identification (de Castro & de Castro, 1989; Wansink, Cheney, & Chan, 2003). Also, this concept of “comfort food” does not relate to the perceived oral comfort during food consumption.

Consequently, the aim of the present study was to explore the concept of “oral comfort” when eating a food in the elderly population. A first step consisted in running focus groups with elderly people in order to develop a questionnaire to evaluate the oral comfort when eating a food (qualitative phase). A second step consisted in asking elderly people to evaluate various meat and cereal products using this questionnaire (quantitative phase). Expected results of these studies were i) to set up a definition of “oral comfort” when eating a food in the elderly population, ii) to propose a validated tool, suitable for elderly people, to evaluate the oral comfort when eating a food, and iii) to assess whether the “oral comfort” concept can differentiate food products.

## 2. Developing a questionnaire through focus group to assess oral comfort when eating a food (qualitative phase)

### 2.1. Focus groups

#### 2.1.1. Materials and methods

Three focus groups were organized with 6 elderly people each (13 women, 5 men, mean age = 79.6 ± 5.0). Two focus groups were performed at our laboratory with independently living volunteers, and one was performed in a retirement home with frailer elderly people. The recruitment criteria were the following: older than 65 years old, no acute pathological episodes at the time of the experiment, no cognitive disorder and able to express themselves. To check these last criteria, participants completed the Mini Mental State Examination (MMSE). Only participants scoring at least 24 out of 30, meaning normal cognition, were included in the study (Folstein, Folstein, & McHugh, 1975).

For the two focus groups performed with independently living volunteers, we managed to have volunteers ranging from a poor to a good oral health in each group, based on the number of functional units (i.e. a pair of posterior antagonist teeth that had at least one contact area during chewing.) and salivary flow rates (Gupta, Epstein, & Sroussi, 2006; Leake, Hawkins, & Locker, 1994). For a first group (n = 6), the number of functional units varied from 2 to 9 and the salivary flow rates varied from 0.076 ml/min to 0.697 ml/min and 0.285 ml/min to 4.012 ml/min for the resting and stimulated salivary flows respectively. For a second group (n = 6), the number of functional units varied from 2 to 8 and the salivary flow rates varied from 0.049 ml/min to 0.631 ml/min and 0.295 ml/min to 2.182 ml/min for the resting and stimulated salivary flows respectively. In parallel, the ability to swallow was tested through the three following tests: measure of tongue pressure, ability to form a food bolus ready to be swallowed safely and glatzel mirror test to detect velopharyngeal insufficiency (Chow et al., 2015). Based on the tests’ results, none of the volunteers presented swallowing disorders. However, it was not possible to carry out dental exams and salivary flow measurements for the volunteers living in nursing home, but it was checked with the nurses that none of the volunteers presented swallowing disorders.

During the focus groups, the moderator directed the flow of the discussion and ensured that all of the important issues were discussed. Before starting the discussion a short introduction about the subject of

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