Food Quality and Preference 56 (2017) 55–68

Contents lists available at ScienceDirect

Food Quality and Preference

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

Comparison of Rate-All-That-Apply (RATA) and Descriptive sensory Analysis (DA) of model double emulsions with subtle perceptual differences

A.K.L. Oppermann [a,b], C. de Graaf [a], E. Scholten [b], M. Stieger [a], B. Piqueras-Fiszman [c,*]

[a] Division of Human Nutrition, Wageningen University, P.O. Box 8129, 6700 EV Wageningen, The Netherlands
[b] Physics and Physical Chemistry of Foods, Wageningen University, P.O. Box 17, 6700 AA Wageningen, The Netherlands
[c] Marketing and Consumer Behaviour Group, Wageningen University, P.O. Box 8130, 6706 KN Wageningen, The Netherlands

A R T I C L E I N F O

Article history:
Received 18 May 2016
Received in revised form 26 September 2016
Accepted 26 September 2016
Available online 28 September 2016

Keywords:
Research methodology
Sensory characterization
Rate-All-That-Apply (RATA)
CATA
Descriptive sensory profiling

A B S T R A C T

The Rate-All-That-Apply (RATA) method, an intensity-based Check-All-That-Apply (CATA) variant, has recently been developed for sensory characterization involving untrained panellists. The aim of this study was to investigate the sensory profiles of ten model (double) emulsions with subtle perceptual differences obtained from the Rate-All-That-Apply (RATA) method with untrained panellists (n = 80). For this purpose two different analysis approaches were followed (treating the data as frequencies and as intensities) and then compared to results obtained from Descriptive Analysis (DA) with trained panellists (n = 11). The RATA method was adapted by including a short familiarization session to acquaint participants with the RATA methodology, the use of the scale, the sensory terms, and product differences. The comparison involved discriminative ability and configuration similarity by means of Multiple Factor Analysis (MFA) and R_V coefficients.

The results in our study show that the RATA intensity approach resulted in higher discriminative ability compared to the RATA frequency approach. Both RATA frequency and RATA intensity resulted in similar overall configurations compared to DA. However, important differences between the use of RATA and DA scales suggest that these overall similarities should be interpreted with caution and warrant a deeper investigation on how RATA scales are understood and used by consumers.

1. Introduction

Generic Descriptive Analysis (DA) with trained panels has been widely used to profile sensory properties of foods and beverages since it provides detailed, consistent, and reliable results (Stone & Sidel, 2004). However, the economic and time consuming aspect of training a sensory panel can be an issue for academic organizations and food industry (Varela & Ares, 2014). Therefore, several consumer-based sensory profiling methodologies have been developed in sensory testing as more rapid and flexible alternatives to DA (Varela & Ares, 2012). Reduced time investment, costs, and training requirements in combination with consumers describing the sensory properties of products instead of analytically trained subjects are key advantages. Consumer-based sensory profiling methodologies can be based on the evaluation of global differences (e.g., sorting and Napping®), the comparison with product references (polarized sensory positioning), global description of individual products (open-ended questions), and on the evaluation of individual terms (e.g., free choice profiling, flash profiling, and Check-All-That-Apply (CATA; Varela & Ares, 2014). For sensory product profiling, also attribute-based methods like intensity scaling, Just-About-Right tasks and Ideal Profile Method have been explored with untrained panellists to indirectly or directly provide sensory profiles (Varela & Ares, 2014).

With the CATA method, consumers are provided with a checklist of predefined terms and asked to select all those terms that apply to describe a given product (Adams, Williams, Lancaster, & Foley, 2007). Previous studies have shown that CATA provides reliable product descriptions comparable to those generated by trained panellists (Ares, Deliza, Barreiro, Giménez, & Gámbaro, 2010; Jaeger et al., 2013). However, the binary response of CATA does not allow a direct measurement of the intensity of the evaluated sensory terms. As elaborated by Ares et al. (2014), this could hamper detailed descriptions and discrimination between products with similar sensory properties. Therefore, Ares et al. (2015)

* Corresponding author.
E-mail address: betina.piquerasfiszman@wur.nl (B. Piqueras-Fiszman).

http://dx.doi.org/10.1016/j.foodqual.2016.09.010
0950-3293/

recommended against the use of CATA questions with untrained consumers for sensory profiling of products with small sensory differences. In this case, CATA questions used by untrained consumers may not provide equivalent information as DA with trained panellists. Recently, Rate-All-That-Apply questions (RATA) have evolved from CATA questions by including intensity ratings of the terms that have been selected. Across a number of studies, Ares et al. (2014) showed that RATA questions, in comparison to CATA, led to an increase in the total number of selected terms. However, even though the total number of selected terms increased, the percentage of selected terms that significantly discriminated the products only increased slightly. Reinbach, Giacalone, Ribeiro, Bredie, and Frøst (2014) even found a decrease in significant differences when RATA was used, which could be due to the lack of training in rating the intensity of terms and therefore inconsistent use of scales, leading to variability in consumers' ratings. Giacalone and Hedelund (2016) recently investigated the reproducibility at assessor-, attribute- and panel-level of the RATA methodology with semi-trained assessors. Assessors were trained during four sessions and subsequently evaluated chocolate samples in quadruplicate. They found that within-assessor reproducibility was moderate and that product maps obtained from individual replicates at panel-level showed high configurational agreement.

It is also worth noting that reported RATA studies so far have involved generally familiar foods such as beer, bread, gummy lollies, peanuts, and apples (Ares et al., 2014; Meyners, Jaeger, & Ares, 2016; Reinbach et al., 2014). These products are relatively easy for consumers to profile. However, it is unclear whether RATA results with untrained panellists would be similar to DA results with trained panellists, or how results from RATA as frequencies of selection only (CATA) would compare to results from RATA as intensities, when non-commercial stimuli such as emulsions with very subtle differences are used.

The food stimuli of interest in the present study are model food emulsions. Model food emulsions can be engineered to precisely control their physical properties and are frequently used to assess the influence of physical properties on sensory perception (Akhtar, Stenzel, Murray, & Dickinson, 2005; Benjamins, Vingerhoeds, Zoet, de Hoog, & van Aken, 2009; Chung, Smith, Degner, & McClements, 2015). Double ($w_1/o/w_2$) emulsions are particularly interesting for healthier product formulations since they have potential for fat reduction by introducing small water droplets (w_1) inside oil droplets that are dispersed in a continuous water phase w_2. The total interfacial area between oil droplets and outer water phase w_2 is similar for full-fat (o/w_2) emulsions and double ($w_1/o/w_2$) emulsions while reducing total fat content. This makes the study of different double emulsion formulations interesting from a sensory perspective. However, the preparation of double emulsions entails the challenge of stabilizing the small w_1 droplets inside the oil droplets. The level of fat reduction that can be achieved by the introduction of inner water droplets is limited, since more pronounced contact between the small w_1 droplets increases the probability of coalescence with the outer water phase (w_2) during the preparation of the double emulsions. This risk of coalescence can be reduced by gelling those inner water droplets, thereby increasing the possible level of fat reduction (Balcaen, Vermeir, Declerck, & Van Der Meeren, 2016; Oppermann, Renssen, Schuch, Stieger, & Scholten, 2015). In a previous study, we recently investigated the sensory perception of ten reduced-fat double emulsions with a trained sensory panel (Oppermann, Piqueras-Fiszman, De Graaf, Scholten, & Stieger, 2016). The emulsions varied in the level of fat reduction and composition (gelled/non-gelled) of the inner w_1 phase and were compared to a full-fat reference sample. The study showed that fat-related sensory perception between full-fat emulsions and fat-reduced double emulsions was very similar, with small significant differences detected for the sensory term creaminess. Double emulsions with a gelled inner w_1 phase further enhanced thickness and cohesiveness perception compared to non-gelled versions. Fattiness perception did not differ across emulsions, which was attributed to the total interfacial area that remained the same. Small changes in sensory perception were assumed to be partly attributed to changes in lubrication properties. Overall, we concluded that the differences between stimuli were subtle.

The motivation of the current research is to investigate whether untrained panellists could also discriminate such a set of non-commercial samples with subtle perceptual differences of a generally unfamiliar product category.

The main aim of this study was therefore to compare different approaches to analyse RATA data of samples with subtle differences and to investigate whether data from untrained subjects performing RATA can lead to the same overall general conclusions as data obtained by a trained panel. In contrast to Giacalone and Hedelund (2016), who trained a panel of employees with considerable product expertise during four sessions, we used one familiarization session only to acquaint naïve subjects with the RATA methodology, the use of the scale, and the samples. Intensity rating was implemented by asking participants to rate the intensities for applicable terms on a 9-box scale.

In order to fully investigate the data and compare results to similar studies (Ares et al., 2014; Meyners et al., 2016), RATA data were explored by the frequency of term selection only (treated as CATA data and not taking into account the intensity ratings of selected terms) as well as their intensity scores. Sensory profiles of the model (double) emulsions obtained by DA and RATA (both approaches) were compared for: (1) discriminative ability between methods, and (2) configuration similarity by means of Multiple Factor Analysis (MFA) and R_V coefficients, as well as by inspection of individual configurations.

2. Materials and methods

2.1. Samples

Two sets of emulsions with either 30 or 50% dispersed phase were evaluated. Each set comprised of five model food emulsions differing in the degree of fat reduction. The dispersed phase was either oil droplets or oil droplets filled with varying amounts of (gelled) water droplets, hence various levels of fat reduction (see Fig. 1). Double emulsions were prepared in a two-step process and the process is described in more detail elsewhere (Oppermann et al., 2016). First, primary (w_1/o) emulsions were prepared by mixing 30, 40 or 50 wt% inner water phase containing 0.4 wt% NaCl with sunflower oil containing a lipophilic emulsifier (polyglycerol polyricinoleate, PGPR) in a high shear blender (Waring blender 8011 ES, Stamford, CT). In case of gelled water droplets, gelatin (10 wt%) was added to the inner water phase, and gelation was induced by subsequent cooling a heated emulsion. Double emulsions were prepared by dispersing 30 wt% of the primary (w_1/o) emulsions in 70 wt% of the outer water phase containing 1 wt% whey protein isolate as hydrophilic emulsifier and 0.2 wt% NaCl using a high shear blender (Ultra Turrax T25 with the dispersing tool S25-N 18G, IKA, Staufen, Germany). Mixing speeds during preparation were adapted to obtain emulsions with similar oil droplet sizes. Fig. 1 and Table 1 provide an overview of the emulsion characteristics. As explained previously in Oppermann et al. (2016), sample names indicate the emulsion type ("OW" for single emulsions, "WOW" for double emulsions), the amount of inner