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Training of a Dutch and Malaysian sensory panel to assess intensities of basic tastes and fat sensation of commonly consumed foods

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ABSTRACT

Taste has a nutrient sensing function and guides food choices. Therefore, investigating taste profiles of dietary patterns – within and across cultures – is highly relevant for nutritional research. However, this demands for accurately described food-taste databases, which are supported with data on the reliability and performance of the sensory panel that determined the taste values.

This study aimed to assess the performance of a trained Dutch and Malaysian sensory panel. More importantly, we assessed whether the standardized training procedure in the two countries yielded similar taste profiles with respect to 15 basic taste solutions, and 19 foods differing in tastes.

A Dutch (n = 15) and Malaysian panel (n = 20) were trained for 56–63 h, using basic taste solutions and reference foods on 6 scales, i.e. sweetness, sourness, bitterness, umami, saltiness and fat sensation. Performance of both panels was described by discrimination, repeatability (RMSE), and agreement. Nineteen products with different sensory characteristics were profiled in the Netherlands and Malaysia; subsequently the obtained taste profiles were compared.

Both panels were able to discriminate between solutions and products (all $p < .001$). A vast majority of the taste values could be reproduced; the RMSEs of the different taste values varied between 2.3 and 13.3%. Panel agreement was achieved after the training with solutions; however not for all attributes of the reference foods. Some taste values of the 19 foods were significantly different, however most of these differences were small (< 10 points).

Our descriptive training procedure yielded two panels from different cultures that were similar in panel performance. More importantly, they obtained similar taste profiles for 19 different foods. This implies that food-taste databases obtained with valid and standardized training procedures may be used to quantify the sensory profiles of dietary patterns of populations.

1. Introduction

The taste of food plays an important role in food choice and dietary patterns (Drewnowski, 1997). The intensity of the taste present in a food can serve as an early signal of the food's nutrient content to ensure the intake of adequate nutrients and avoid the toxic substances (van Dongen, van den Berg, Vink, Kok, & de Graaf, 2012). Sweet taste, for example, may signal energy and carbohydrate content, umami and salty tastes may signal protein and sodium content, bitter taste may indicate toxic components, and sour taste may indicate ripeness of fruits (Temussi, 2009; Yarmolinsky, Zuker, & Ryba, 2009). In addition, the nutrient sensor function of the taste system could affect the process of satiation (de Graaf & Kok, 2010) and subsequent food consumption (Cox, Hendrie, & Carty, 2016; Stubbs, Johnstone, Mazlan, Mbaiwa, & Ferris, 2001).

Dietary patterns have shown to be related to nutritional status and chronic health outcomes in epidemiologic studies (Arimond & Ruel, 2004; Fung et al., 2001). Previous studies showed that taste contributes highly to food palatability and acceptancy (Shimojo et al., 2014; Sorensen, Moller, Flint, Martens, & Raben, 2003). As taste is such an important factor in determining dietary patterns, it is important to also consider the taste profiles of the population's diet.

In addition, given the profound cultural differences in terms of people's food preferences and their consumption behaviours (Kittler &

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Sucher, 2007), it is particularly interesting to gain more insight into the similarities or differences of dietary taste patterns across cultures. Studying dietary patterns across cultures from a taste perspective, provides us with a deeper understanding of the role of taste in food choice and dietary intake in diverse population and further associated to potential nutrition-related health outcomes, for example weight status, and chronic diseases such as cardiovascular disease.

Multiple research groups have shown their interest in the relation between taste profiles of foods and food consumption patterns. So far, three taste databases – listing the taste profiles of an array of commonly consumed foods – have been described (Lease, Hendrie, Poelman, Delahunty, & Cox, 2016; Martin, Visalli, Lange, Schlich, & Issanchou, 2014; van Dongen et al., 2012). The databases originate from different countries: the Netherlands (van Dongen et al., 2012), France (Martin et al., 2014) and Australia (Lease et al., 2016). All three databases were compiled using a trained group of subjects to objectively score the taste profiles of the foods. Yet, the description of these databases gives little information on the panel training and panel performance. However, this information is essential to interpret the accuracy and validity of the food-taste databases and eventually the taste profile of food consumption patterns.

Trained panels are commonly used as an objective measure to quantify sensory properties of foods (Meilgaard, Carr, & Civille, 2006). Training increases the panel's internal consensus, repeatability and discriminative power (Chollet & Valentin, 2001; Loso, Gere, Györey, Kokai, & Sipos, 2012; Wolters & Allchurch, 1994). Sufficient training hours (Chambers, Allison, & Chambers, 2004; Chambers, Bowers, & Dayton, 1981) and frequent panel performance monitoring (Donnell, Hulin-Bertaud, Sheehan, & Delahunty, 2001; Labbe, Rytz, & Hugi, 2004) are essential to have an effective trained panel. Training methods have been described for a single trained panel (Hootman, 1992; Meilgaard et al., 2006), however not for a cross-cultural trained panel.

It has been suggested that the cultural background of individual panellist may affect taste perception, as individuals have different genetic backgrounds, dietary habits and thus different experiences to taste (Garcia-Bailo, Toguri, Eny, & El-Sohemy, 2009; Holt, Cobiac, Beaumont-Smith, Easton, & Best, 2000). It is therefore likely that cross-cultural panels have more variability than two panels within the same country. Several attempts have been made on the comparison of trained panels within a similar culture (*i.e.* Western *vs.* Western or Eastern *vs.* Eastern) (for example Chung & Chung, 2007; Ramón Canul et al., 2011). However, little information is publically available on the performance of different panels across cultures, that is between Western and Eastern.

To date, no panel performance data using Spectrum™ scales has been described. The Spectrum™ method is known as a quantitative descriptive analysis method using a series of frame of references to obtain absolute sensory/taste values. In addition, the Spectrum™ reference points are based on solutions of simple tastants, which are standardised across countries. We therefore, hypothesized that we can minimize cultural influences, and obtain similar results across two panels, *i.e.* Asian and Caucasian, by using standardised training inspired by the Spectrum™ method.

In the current paper, we aim to assess the extent to which an extensive training procedure with Dutch and Malaysian panels yields similar taste profiles with respect to 15 basic taste solutions and a selection of 19 foods using quantitative reference rating scales. To this aim, we developed a training procedure and rating scales for a Dutch and a Malaysian sensory panel based on the universal sapid Spectrum™ scales (Muñoz. & Civille, 1992). We added reference foods to the scale in order to facilitate future food-to-food taste profiling; as it is difficult to compare taste intensity between simple sapid solutions and complex foods. Umami was included based on the data of French group (Martin, Tavares, Schwartz, Nicklaus, & Issanchou, 2009), and fat sensation was added as it is important from a nutritional point of view.

Moreover, in the current manuscript we describe the panel performance within each panel, that is discriminatory ability, repeatability, agreement; and compare the performance between the two panels. It is noteworthy that this panel-comparison study was performed on a wide array of foods, other than those of other panel-comparison studies that targeted to certain specific foods (Chung & Chung, 2007; Pagès, Bertrand, Ali, Husson, & Lê, 2007; Ramón Canul et al., 2011; Risvik, Colwill, McEwan, & Lyon, 1992).

2. Materials and methods

2.1. Selection of the sensory panels

Dutch and Malaysian adults (18–55 y) were recruited from Wageningen and Subang Jaya by means of university volunteer contact database, advertisement and peer-to-peer referral. Forty-six Dutch subjects and fifty-five Malaysian subjects showed interest in the study, came to the information meeting and filled out an inclusion questionnaire. Subjects were eligible if they had a normal self-reported BMI (18.5–25 kg/m^2) and could provide long-term commitment. Exclusion criteria were: use of medication, health issues affecting taste or smell, smoking or using drugs, excessive alcohol consumption (≥21 units/week, where 1 unit = 1 serving), having specific dietary restrictions (*e.g.* vegetarians) and food allergies/intolerances, dental limitations (*e.g.* denture, tongue piercing or difficulties in chewing and swallowing) and being/expecting to be pregnant or lactating during the study period. From the interested subjects, 35 Dutch and 34 Malaysian individuals were eligible. These participants were then invited for a 2-h screening visit during which their tasting capabilities were tested and their height and weight were measured. Each participant was asked to wear light clothing and no shoes during anthropometric measurements. Body weight and height were measured to the nearest 0.1 kg and 0.1 cm, respectively, using an electronic scale with attached stadiometer (SECA 220, Germany). Furthermore, taste recognition, taste discrimination and concentration span were tested. All selected subjects scored above the acceptance points of the three test procedures mentioned below (see Table 1).

Taste recognition was tested with the Mueller taste strips (Mueller et al., 2003). During this test, subjects identified the five basic tastes, *i.e.* sweet, sour, salt, bitter, and umami. The minimum acceptance of this test was set at > 70%. Discrimination was tested by means of ranking basic solutions of all basic tastes according to their taste intensity as described by Jellinek (1985). For each taste the acceptance was set at > 50%. Last, concentration span during a complex task was tested by means of the Bourdon test (Bourdon T.I.B test, Swets & Zeitlinger BV, Calisse, The Netherlands) (Lesschaeve & Issanchou, 1996). The minimum acceptance of this test was set at 40%. All the acceptance

Table 1
General characteristics of Dutch and Malaysian panellists.

	Dutch (n = 15)	Malaysian (n = 20)
	Mean ± SD	
Age (*years*)	33.0 ± 12.2	21.4 ± 2.7
Gender[a]		
- Male	3 (20.0)	3 (15.0)
- Female	12 (80.0)	17 (85.0)
Body weight (*kg*)	68.4 ± 8.2	59.1 ± 16.9
Height (*m*)	1.73 ± 0.07	1.62 ± 0.10
Body Mass Index (kgm^{-2})	22.9 ± 2.3	22.2 ± 4.2
PROP (6-n-propylthiouracil) status[a,b]		
- Non-taster (≤15.5)	5 (33.3)	1 (5.0)
- Normal and super taster (> 15.5)	10 (66.7)	20 (95.0)

[a] n (%).
[b] Panels' PROP status was measured with the one-solution method described by Tepper, Christensen, and Cao, 2001, with group classification of non-, normal and supertasters, using a 100 mm labelled magnitude scale.