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Evaluation of the Pivot Profile©, a new method to characterize a large variety of a single product: Case study on honeys from around the world

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ABSTRACT

Honey is a natural product with very diverse sensory attributes that are influenced by the flower source, the bee species, the geographic origin, the treatments and conditions during storage. This study aimed at describing 50 honeys from diverse flower sources in different continents and islands, stored under various conditions. Many articles have been published on the sensory characterization of honeys, thus a common list of attributes has been established, but it appeared to be poorly suited to describe a large number of honeys from around the world. This is why the novel and rapid sensory evaluation method, the Pivot Profile©, was tested, with the participation of 15 panelists during five sessions. The first objective was to obtain a sensory description of the 50 honeys that were tested. From 1152 distinct terms, a list of 29 sensory attributes was established and the attributes divided into three categories: color/texture (8 terms), aroma (16 terms), and taste (5 terms). At first, the honeys have been ranked according to their level of crystallization from fluid/liquid to viscous/hard. Then color was the second assessment factor of the variability. In terms of aroma, honeys from Africa were characterized by smoky, resin, caramel and dried fruit as opposed to floral and fruity, mainly for honeys from South America and Europe. Finally, the honeys were ranked according to their sweetness. The second objective of this study was to test the new sensory method, called Pivot Profile© which is used to describe a large number of products with interpretable results.

1. Introduction

Honey is a complex natural product that is produced by different bee species from flower nectar or honeydew, generally with very low input from humans. Honey is composed of a high sugar concentration, mainly fructose and glucose, as well as > 200 other different components like minerals, proteins, vitamins, organic acids, flavonoids, phenolic acids and enzymes that are beneficial to human health. Honey is indeed recognized as an antioxidant (Ferreira, Aires, Barreira, & Estevinho, 2009) and antiseptic. Thanks to its unique composition, honey is suited for long-term storage although some alterations may occur. Each honey is very specific, due to its chemical composition and sensory attributes that are influenced by many parameters, such as the bee species, the flower source, the geographical region, or the storage condition.

The variety of flowers seems to be the main source of honey variability, as shown in a study by de Sousa et al. (2016), in which no significant sensory difference was detected between honeys from the same flower variety obtained by two different bee species in a Brazilian semi-arid region. The flower source seemed to influence the pH of the product, its glucose concentration or water content (however, these parameters are also influenced by climatic conditions) (Silvano, Varela, Palacio, Ruffinengo, & Yamul, 2014). It was also possible to discriminate the botanical origin of different honeys by chemical analysis (Castro-Vázquez, Díaz-Maroto, González-Viñas, & Pérez-Coello, 2009; Karabagias, Badeka, Kontakos, Karabournioti, & Kontominas, 2014).

Poor storage conditions may alter sensory attributes and modify the products chemical composition. The storage temperature has a significant impact on the quality of the honey, as shown by Castro-Vázquez, Alañon, Gonzalez-Viñas, and Pérez-Coello (2012). In their study the same heather honey was exposed to three different storage temperatures. They found that “balsamic and floral” odors decreased in heather honey stored at 20 °C while “medicinal, toasted” and “acid” tastes increased at 40 °C, compared with the same honey stored at 10 °C. These sensory modifications were correlated with the formation of volatile molecules.

Sensory evaluation appears to be a very useful tool to describe honey characteristics and to evaluate consumer acceptability. Bruneau,

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Barbier, Gallez, and Guyot-Declerck (2000) created the first "odor and aroma wheel for honey". Anupama, Bhat, and Sapna (2003) developed a list of 14 descriptors divided into four categories: appearance, mouthfeel, aroma and taste. Persano Oddo and Piro (2004) developed a handout to evaluate honey quality, which included a sensory analysis, a melissopalynological analysis and a physicochemical analysis. Galán-Soldevilla, Ruiz-Pérez-Cacho, Serrano Jiménez, Jodral Villarejo, and Bentabol Manzanares (2005), developed a new list of sensory attributes, categorized in another four categories; odor, texture, flavor and trigeminal sensations.

In most studies on honey, the Quantitative Descriptive Analysis or its variant, the Ranking Descriptive Analysis (de Sousa et al., 2016), were used. González-Viñas, Moya, and Cabezudo (2003) and Deliza and Vit (2012) applied the Free Choice Profiling method which provided good results. Several methods have recently been developed to overcome the long and time-consuming phase of the specific vocabulary development and the panelist training sessions. These new methods are faster and very well-adapted to products with little known sensory attributes and/or which have high heterogeneity. According to Valentin, Chollet, Lelièvre, and Abdi (2012) these methods can be categorized into three classes. The first group includes the verbal-based methods with Flash profile (Dairou & Sieffermann, 2002) and Check-all-that-apply (Ares et al., 2013). The second group gathered the similarity-based methods with Free sorting task (Faye et al., 2004) and Napping® (Pagès, 2005). The third group pooled the reference-based methods, which includes the latest methods, *i.e.* the Polarized Sensory Positioning (Teillet, Schlich, Urbano, Cordelle, & Guichard, 2010) and the Pivot Profile© (Esmerino et al., 2017; Fonseca et al., 2016; Thuillier, Valentin, Marchal, & Dacremont, 2015). These two methods, which offer the opportunity to describe a very large number of products, are comparative methods using a constant reference over time.

Previous studies focused on the comparison of honeys from specific countries such as Spain (Castro-Vázquez et al., 2009; Castro-Vázquez, Leon-Ruiz, Alañon, Pérez-Coello, & González-Porto, 2014; Lucía Castro-Vázquez et al., 2012; Galán-Soldevilla et al., 2005; González-Viñas et al., 2003; Rodriguez, Salud, Hortensia, Luis, & Jodral, 2010), India (Anupama et al., 2003; Aparna & Rajalakshmi, 1999), Etiopia (Belay, Solomon, Bultossa, Adgaba, & Melaku, 2015) or Brazil (de Sousa et al., 2016; Ferreira, Lencioni, Benassi, Barth, & Bastos, 2009) but none compared honeys from countries around the world. The aim of the present study is two-fold: (i) to describe a large number of honeys from around the world, which have a high variability in terms of flower source, bee species and storage conditions and (ii) to test the Pivot Profile© method and its capacity to provide informative sensory descriptions.

2. Material and methods

2.1. Honey samples

350 honeys of *Apis cerana* (Asia) and *Apis mellifera* (rest of the world) were collected around the world by collaborators of the botanical garden at Neuchâtel during four years from 2012 to 2016 with 66% of them collected in spring 2013. A data base has been created with geographical coordinates of honey's production region (Mitchell, Mulhauser, Mulot, & Aebi, 2017). Depending on the accuracy of producer information, there were four levels of precision for geographical localization: second, minute, degree or "center of nation". Among these 350 honeys, a sub-sample of 50 honeys was selected for both: representing all continents and available in sufficient quantity (160 ml) to perform the sensory evaluation (Table 1). The honeys were classified by continent or sub-continent. All samples were stored at ambient temperature (< 20 °C) in their initial package without direct light for several months before tasting. Honey is known as being a very stable product due to its low level of water content. Five days before a tasting session, the samples were distributed into four glass pots (40 ml per pot) identified by a three-digit code. Two third of the samples needed to be heated to liquefy before being transferred into the pot. Samples that separated themselves in two phases were stirred for homogenization 1 h before the tasting.

Table 1
List of the 50 honeys with their continent and country of origin.

Code	Continent	Country/state	Code	Continent	Country/state
E01	Europe	Portugal	AmN01	North America	Florida
E02		Switzerland	AmN02		Maine
E03		Norway	AmN03		Quebec
E04		Germany	AmN04		California
E05		France	AmN05		Canada
E06		Liechtenstein	AmN06		Wisconsin
E07		Latvia	AmN07		Oregon
E08		Poland	AsSE01	Southeast Asia	Borneo
E09		Spain	AsSE02		China
E10		Portugal	AsSE03		Nepal
Af01	Africa	Burkina Faso	AsSE04		Borneo
Af02		Eritrea	AsSE05		Burma
Af03		Tunisia	AsSE06		India
Af04		Nigeria	ASW01	Western Asia	Iran
Af05		Cameroon	AsW02		Yemen
Af06		South Africa	AsW03		Turkey
Af07		Ghana	AsW04		Israel
Af08		South Africa - Bush	AsW05		Israel
Af09		South Africa	AsW06		Socotra Island
Af10		Madagascar	Oc01	Oceania	Australia
AmS01	South	Argentina	Oc02		New Zealand
AmS02	America	Chile	Oc03		Tasmania
AmS03		Brazil	Oc04		Niue Island
AmS04		Brazil	Oc05		Tahiti
AmS05		Chile			
AmS06		Martinique			

Lelièvre-Desmas, Valentin, and Chollet (2017) found that the choice of the pivot has no strong impact on the product positioning. As honey is a non-mixable product, the most neutral honey available was chosen as the reference (pivot) honey. It was a liquid multi-flower honey from the "Lune de Miel" company sold in French supermarkets, a mix of honeys from a large variety of European flowers and a best-seller in France. Having no specific aroma, it has been considered as "neutral" by the sensory lab members.

2.2. Panel

The tasting panel included 11 female and 8 male participants. The panelists were trained in sensory evaluation once a week for two to seven years, depending on the participant, before taking part in this study. These panelists were primarily trained on wine but they were used to taste other products. Sensory sessions were run for five weeks (once a week) and the number of panelists varied from 12 to 15 per session. Each honey was assessed 13 to 17 times.

A specific training was done for this study. Panelists received two lists of attributes, one based on Piana et al. (2004) and a second based on Galán-Soldevilla et al. (2005). The first session was dedicated to getting used to the product honey and the Pivot Profile© method. Five honey samples and one pivot were chosen from a commercial market. During the second and third session, panelists performed a Napping® (Pagès, 2005) with the 50 honeys studied, based, respectively, on visual and odor characteristics (data not shown). For these tasks, panelists were asked to get a consensus in each group of four or five people on common words to describe the different honeys.

2.3. Tasting organization

The distribution of the samples were randomized according to a complete Latin square design, which was then divided in five sub-parts