Food Quality and Preference 68 (2018) 113–124

Contents lists available at ScienceDirect

Food Quality and Preference

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

Associations between food neophobia and responsiveness to "warning" chemosensory sensations in food products in a large population sample

M. Laureati[a,*], S. Spinelli[b], E. Monteleone[b], C. Dinnella[b], J. Prescott[b,c], C. Cattaneo[a], C. Proserpio[a], A. De Toffoli[b], F. Gasperi[d], I. Endrizzi[d], L. Torri[e], M. Peparaio[f], E. Arena[g], F. Bonello[h], N. Condelli[i], R. Di Monaco[j], E. Gatti[k], E. Piasentier[l], F. Tesini[m], E. Pagliarini[a]

[a] University of Milan, Italy
[b] University of Florence, Italy
[c] TasteMatters Research & Consulting, Sydney, Australia
[d] Edmund Mach Foundation, San Michele all'Adige, Italy
[e] University of Gastronomic Science, Bra, Italy
[f] CREA – Research Centre on Food and Nutrition, Rome, Italy
[g] University of Catania, Italy
[h] CREA – Research Center for Enology, Asti, Italy
[i] University of Basilicata, Potenza, Italy
[j] University of Naples – Federico II, Italy
[k] IBIMET-CNR, Bologna, Italy
[l] University of Udine, Italy
[m] University of Bologna, Italy

ARTICLE INFO

Keywords:
Food neophobia
Arousal
Liking
Fungiform papillae
Prop
Bitterness
Astringency

ABSTRACT

The aim of the present study is to explore the association between food neophobia and chemosensory responsiveness and to determine whether this association translates into different food liking and preference patterns. Data were collected on 1225 respondents (61% females, age 20–60 years) as part of the Italian Taste project. Respondents completed the *Food Neophobia Scale* (FNS) as well as a food preference and familiarity questionnaire for a number of foods and beverages categorized as mild or strong tasting. Moreover, they evaluated attribute intensity and liking of an actual food (dark chocolate pudding) varying in the level of sweetness, bitterness and astringency. Taste function was evaluated by measuring fungiform papillae density (FPD), responsiveness to PROP (6-n-propylthiouracil) and to water solutions representing various oro-sensory qualities.

High, medium and low neophobic subjects did not differ for FPD and chemosensory responsiveness. Reported liking was significantly lower for high neophobics than low neophobics mainly for those vegetables and beverages characterized by high levels of warning stimuli (i.e. bitterness, sourness, astringency and alcohol), whereas almost no differences were found for the bland versions of food items. High and medium neophobics rated astringency and, to a lesser extent, bitterness of the dark chocolate pudding, as more intense than low neophobics and liked the most bitter and astringent variants significantly less than low neophobics.

Differences in liking, however, do not seem to be mediated by high food neophobics' superior taste functioning but rather by higher levels of arousal when eating food and/or drinking beverages that are perceived as unpleasant and potentially dangerous. Finally, the effect of food neophobia was evident not only for unusual items in the Italian food context, but even for items that might be considered highly familiar.

1. Introduction

Food neophobia, defined as the reluctance to eat unfamiliar foods, is a characteristic that all omnivores, including humans, share (Pliner & Hobden, 1992). This food behavior is a heritable trait (Knaapila et al., 2007) which has been preserved from one generation to another making some individuals extremely selective about food, presumably as a means to avoid the potential toxicity of an unknown food source. Even in modern society, where food safety is generally guaranteed and the protective purpose of food neophobia has lost importance, up to

* Corresponding author at: Department of Food, Environmental and Nutritional Sciences (DeFENS), Via Celoria 2, 20133 Milan, Italy.
E-mail address: monica.laureati@unimi.it (M. Laureati).

https://doi.org/10.1016/j.foodqual.2018.02.007
Received 27 October 2017; Received in revised form 11 January 2018; Accepted 15 February 2018
Available online 17 February 2018
0950-3293/

35% of individuals show a selective attitude toward food (Kauer, Pelchat, Rozin, & Zickgraf, 2015; Zickgraf & Schepps, 2016). Similar percentages have been reported in two large-scale studies on USA (Meiselman, King, & Gillette, 2010) and New Zealand (Jaeger, Rasmussen, & Prescott, 2017) population samples, with high neophobic individuals accounting, respectively, for 40–45% and 30% of the total population.

Food neophobia (FN) and food selectivity are considered maladaptive behaviors as they decrease diet variety, thus having potentially important nutritional consequences. Recent evidence suggests that, in adults, FN is negatively related to daily fruit and vegetables intake and to diet variety in general (Jaeger et al., 2017; Zickgraf & Schepps, 2016). Moreover, an association between FN and increased body mass index has been observed (Proserpio, Laureati, Invitti, & Pagliarini, 2018) as neophobic individuals may choose to eat familiar food which is more energy dense than fruit and vegetables (Knaapila et al., 2011) or may be less willing to try healthy alternative versions of familiar products (Monteleone et al., 2017; Schickenberg, van Assema, Brug, & de Vries, 2008).

Although FN has been studied extensively, especially in children, relatively little information is available on its causal origins and relationship to eating behavior in adults. Knaapila et al. (2011) reported high neophobic reactions for fruit and vegetables, fish and meat but no effect of FN was observed on frequency of use of energy dense foods in a large sample of young adults. Similar findings have been reported in children (Cooke, Wardle, & Gibson, 2003), but it remains unclear why FN is particularly high for certain food categories. Some authors suggested that this behavior may be due topersonality traits (Dovey, Staples, Gibson, & Halford, 2008), whereas others reported perceptual (Coulthard & Blissett, 2009) or genetic reasons (Knaapila et al., 2007, 2011). More likely, the specificity of FN is due to the concurrence of all these factors.

An important aspect for novel food refusal is the expectation that the sensory properties of food may be unpleasant (Pliner, Pelchat, & Grabski, 1993). In this context, individual difference in taste responsiveness may play an essential role in moderating this effect. Polymorphisms in the TAS2R38 gene may lead to variation in the perception of the bitterness of 6-n-propylthiouracil (PROP), with individuals classed as ‘supertasters’ (STs), ‘medium tasters’ (MTs) or ‘nontasters’ (NTs) (Bartoshuk, Duffy, & Miller, 1994). Despite some contradictory data in the literature, higher taste responsiveness to PROP has been associated with greater perception of a variety of oro-sensory stimuli including sensations from bitter/astringent fruits and vegetables, fruit juices, and alcoholic beverages (Dinehart, Hayes, Bartoshuk, Lanier, & Duffy, 2006; Lanier, Hayes, & Duffy, 2005; Melis et al., 2017; Tepper et al., 2009). Moreover, when compared with PROP non-tasters, PROP tasters perceive sourness (Prescott, Soo, Campbell, & Roberts, 2004) and the burning sensations from ethanol and spices (Prescott et al., 2000) more intensely. In general, STs also express greater dislike and more frequent rejection of astringent, bitter and sour fruits and vegetables compared to NTs (Hayes, Feeney, & Allen, 2013; Monteleone et al., 2017; Sandell et al., 2015). Moreover, a greater PROP responsiveness seems to be associated with diets rich in saturated fatty acid and added sugars, in contrast to plant-based diets (Stevenson et al., 2016). Since FN is considered an adaptive, evolutionary response, which prevents from the ingestion of poisonous substances more commonly found in fruits and vegetables (i.e., bitter, sour, and astringent compounds) (Pliner & Salvy, 2006), it is reasonable to hypothesize that food neophobics might be more sensitive to such “warning” chemosensory signals, detecting even subtle changes of these stimuli in food.

Quite surprisingly, there has been very little research carried out to ascertain whether taste responsiveness varies according to the degree of FN, and whether individual differences in perception may contribute to influence food preference and choice among neophobics and neophilics. Törnwall et al. (2014), in a large-scale study on twins, showed large differences in liking of foods with specific flavor qualities (e.g. sour fruits, berries, spicy foods and spices), but showed no differences in the liking of bland foods (salty-and-fatty foods, sweet-and-fatty foods, and fish), as a function of FN. The food neophilic group (food adventurous group), expressed higher liking for sour and spicy foods compared to the less neophilic group (basic group) and had more tolerance for capsaicin burn when tasted in model food. Interestingly, the two groups did not differ in their PROP responsiveness, or in their ratings of the intensity of sour and pungent stimuli.

Ullrich, Touger-Decker, O’Sullivan-Maillet, and Tepper (2004) reported a more complex association between taste responsiveness, rejection of novel food and food preference. They classified subjects according to their frequency of trying new foods as food adventurous or non-adventurous and found that food adventurousness was strongly associated with greater liking of bitter, hot, and pungent foods in PROP tasters, but not in PROP NTs. Only PROP tasters that were less adventurous showed a dislike of bitter, hot, and pungent foods. However, a comparison in PROP responsiveness between the two groups was not explicitly reported.

Although these findings suggest an association between FN, taste responsiveness and food preference, it is unclear whether the food rejection shown by food neophobics is mediated by a physiological predisposition to taste hypersensitivity or instead by higher levels of arousal when approaching new foods. With the possible exception of Törnwall et al. (2014), in which a model food (strawberry jelly) was used, to our knowledge, there have been no studies of FN in large population samples that have evaluated real foods varying in their sensory properties. Indeed, one of the limits of the existing literature on FN is that conclusions are drawn on small datasets thus limiting the explanatory power of FN in relation to other factors associated to food choice and health (Jaeger et al., 2017). Therefore, there is a need for further exploration of FN in larger population samples in order to examine its causal origins and its impact on food preferences and choices and its potential consequences on human health.

The present paper is part of the *Italian Taste* project, a large-scale study aimed at exploring the associations among biological, genetic, physiological, sociocultural, psychological and personality-related factors, describing the dimensions of food liking, preference, behavior and choice, and their relevance in determining individual differences within a given food culture framework (Monteleone et al., 2017).

Assuming that people high in FN tend to reject foods, in particular vegetables that are often characterized by “alarm” sensations such as sourness, bitterness and astringency, we wanted to explore whether the reluctance to consume such foods might reflect greater chemosensory responsiveness. The hypothesis is that food neophobics show higher taste responsiveness, which lead them to perceive “warning” chemosensory sensations as more intense than do neophilics. The increased responsiveness in food neophobics might justify the reduced liking for a variety of foods with high levels of “warning” sensations often experienced in many vegetables and healthy products. To test this hypothesis, we studied a sample of 1225 individuals who were assessed for taste functioning by measuring fungiform papillae density (FPD) and PROP responsiveness as well as the intensity of solutions representing the basic tastes and astringency. Respondents also completed the Food Neophobia Scale (FNS) and a food preference and familiarity questionnaire for a number of foods and beverages that could be categorized as mild or strong tasting. Food preference for warning stimuli was also tested using a real product (i.e., chocolate pudding) which was evaluated for liking and intensity of sweetness, bitterness and astringency.

2. Material and methods

2.1. Participants

Data were collected on 1225 Italian consumers (61% female; age range 20–60 years). Male and female mean ages were 37.0 years (SD = 13.1) and 36.8 years (SD = 12.7), respectively. The age