Consumer acceptance of insects as food: revision of food neophobia scales

by Gómez-Luciano, C.A., Rondón Domínguez, F.R., Vriesekoop, F. and Urbano, B.

DOI link to the version of record on the publisher's site

Gómez-Luciano, C.A., Rondón Domínguez, F.R., Vriesekoop, F. and Urbano, B. 2021. Consumer acceptance of insects as food: revision of food neophobia scales. *Journal of International Food & Agribusiness Marketing*

10 March 2021

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This study aimed to get insight into the acceptance of insects as food using neophobia descriptors. Data were collected through questionnaires applied to a Spanish-Dominican sample. Models were created using binary logistic regression, and determinants of acceptance of insects as food were obtained. The results reveal that Dominicans presented the highest food neophobia and the lowest acceptance of insects as food. The openness to eat almost anything is the positive determinant in Spain for accepting insects as food, while in the Dominican Republic to overstate the benefits of the new food technologies. Principal component analysis was used to calculate the optimal number of descriptors in the neophobia scales; 3-5 descriptors could be removed. Marketers can use these results to better understand how to market insect-based products considering different contexts.

Keywords: psychographic descriptors, cross-cultural analysis, entomophagy, alternative dietary proteins

Introduction

The motives of acceptance and rejection of insects as food are poorly understood and even where a great variety of insect species are more readily consumed, the acceptance or rejection is never random, haphazard or unselective (Caparros Megido et al., 2014). Food taboos with regards to insects are similar to other kinds of food in every society (Yen, 2009). The reasons for food taboos are complex and are thought to be linked to traditions and beliefs, which may dictate which species of insect might be acceptable and which are not (Yen, 2009). The availability of local or indigenous insect species has been considered (House, 2016) however there is no simple and direct explanation why some societies use more (or less) insects as food than others. Some authors explained why humans have neglected insects as a food source. These include the notions that insects are readily perceived as vectors that spread disease; insects are encountered as pests of crops and ornamental plants (van Huis, 2013); and insects are depredators of stored products (House, 2016) and food contaminants (Vriesekoop & Shaw, 2010) together with anticipated negative post-ingestional consequences (Caparros Megido et al., 2014). Verbeke's (2015) analyzed the significant predictors for western consumers to adopt insects and showed that gender, age, familiarity, convenience, environment, future consumption intentions and food neophobia (La Barbera et al., 2018; Sogari et al., 2019) were crucial predictors of acceptance of insects as food; while House (2016) demonstrated that consumers´ psychological factors such as curiosity, social influences (Sogari, 2015) and norms (Holm Jensen & Lieberoth, 2019) , and product exposure (Mancini et al., 2019) are determinant in the adoption of insects as food. Additionally, insects are gaining popularity as an alternative source of proteins to meat (van Huis, 2013; Verbeke, 2015). Insects as food are seen in ethnoculinary applications, cooking contests, TV shows, government publicity, and demonstrations by health and culinary experts (DeFoliart, 2010). Furthermore, the notion of insects as a food source is regularly discussed on social media, cooking blogs, etc. (Verkerk et al., 2007) that is presenting the environmental sustainability and health benefits of insects as food instead the traditional meat (House, 2016; Tilman & Clark, 2014). Where formerly people living in rural areas might have been the principal consumers of a large variety and number of insects (Hartmann et al., 2015), at present they are being eaten by urban people of higher status in different countries where they are becoming a gourmet dish or exclusive delicacy (Yen, 2009). Nevertheless, the uptake of insect as food is still in its infancy and there is a need to more fully elucidate the factors affecting the acceptance of insects as food (House, 2016).

Some authors (Caparros Megido et al., 2014; Testa et al., 2017) have pointed out insects as food could provide complementary food for developed countries and help less developed countries to support their nutritional needs (Yen, 2009). Nevertheless, the acceptance or rejection of insects as food in less developed countries has been little investigated and almost all published research has focused on the acceptance of insects as food in populations such as Belgium (Caparros Megido et al., 2014; Schouteten et al., 2016; Vanhonacker et al., 2013; Verbeke, 2015), Denmark (Verneau et al., 2016), Germany (Hartmann et al., 2015), Italy (Sidali et al., 2019; Verneau et al., 2016), the Netherlands (De Boer et al., 2014; House, 2016; Schosler et al., 2012; Tan et al., 2016), Switzerland (Gmuer et al., 2016), Spain (Castro Delgado et al., 2020), USA (Ruby et al., 2015), Canada (Looy & Wood, 2006), Australia (Yen, 2009) and China (Hartmann et al., 2015). Ruby et al. (2015) indicate that research should focus both on the people in the developed countries who reject insects (about 1 billion) and in the people in the less developed countries who do not consume insects (4 billion). The latter group is the most critical and larger category in the world. This paper develops a comparison of models of acceptance of insects as food in two of those target groups, Spain (SP) and the Dominican Republic (DR). Moreover, the substantial differences in findings in previous works indicate that more empirical research should be developed in order to elucidate the factors affecting acceptance and rejection of insects as food, considering the influence of widely different contexts of the developed countries that reject insects as food and the less developed countries who do not consume insects. Studies which provide empirical data on insect acceptance in worldwide contemporary societies are scarce (House, 2016).

Food Neophobia theoretical framework

Food neophobia is defined as a reluctance to eat unfamiliar foods (Dovey et al., 2008). Literature has identified a general distrust of novel foods and caution towards novel food technologies (Cox & Evans, 2008), as important attitudinal barriers for consumption of some novel products (Damsbo-Svendsen et al., 2017). Thirteen instruments with significantly different measurements outcomes and procedures have been developed to measure food neophobia (Damsbo-Svendsen et al., 2017). One of the instruments currently most used to assess neophobia and willingness to accept unfamiliar foods is the Food Neophobia Scale (FNS) developed by Pliner and Hobden (1992). The FNS is a simple instrument consisting of 10 descriptors which are highly reliable and have quite good measures of validity. It has been discussed what the optimal number of descriptors in the scale (Preston & Colman, 2000) because short and simple instruments capturing the most important information are desirable. In this sense, Ritchey et al. (2003) demonstrated that excluding 2 or 4 descriptors from the FNS improve the method when used in several countries. Furthermore, Damsbo-Svendsen et al. (2017) suspected that several descriptors in the FNS are not relevant in all countries. Van Trijp and Steenkamp (1992) proposed the Variety Seeking Tendency Scale (VARSEEK) that considered terminology such as 'exotic foods' and 'food from other countries', which may no longer be relevant because of the greater incorporation of exotic or ethnic foods 25 years on in modern society. More recently, Damsbo-Svendsen et al. (2017) a revision of instruments to measure neophobia recommended to evaluate the descriptors in the FNS and apply those that are relevant to each individual context.

The paper gets insight the acceptance of insects as food using consumers´ perceptions, food neophobia and food technology neophobia descriptors in Spain and the Dominican Republic and in doing so, contributes to a revision of neophobia scales.

Material and methods

A sample of 401 consumers from Spain (SP) and Dominican Republic (DR) was obtained. The participants responded to a combination of digital and a face-to-face survey. The survey was approved by the Harper Adams University Research Ethics Committee. Additionally, as part of the ethics declaration, each questionnaire also included information for a contact e-mail at HAU, so that questions arising from answering the questionnaire could be addressed. Before answering any questions, all participants were asked to acknowledge an informed consent statement. In the case of minors, under 18 years old in SP and the DR, consent from parents was asked. The questionnaire was written in Castilian Spanish and Dominican Spanish by native speakers, to improve the accuracy of meaning and avoid misunderstandings.

The interviewers from each country, who firstly acted as back translators, were responsible of the survey at national level. The interviewers, from Universidad de Valladolid in SP and Instituto Especializado de Estudios Superiores Loyola in DR, recruited convenient consumers´ sub-samples in their country according to the population of each country. Participants were screened against the inclusion criteria of being of either Spanish or Dominican. The two nationality sample groups were included to examine potential cross-cultural differences. Participants were recruited following a stratified sampling procedure by gender, age group and highest education by population (INE, 2017; ONE, 2015). Due to the stratified sampling procedure, the data showed a representative distribution of the main demographic characteristics, i.e. gender (SP: $X^2 = 0.049$, df = 1, P = 0.824, DR: $X^2 = 0.044$, df = 1, P = 0.833), age (SP mean = 43, t-value = -1.604, P = 0.110, DR mean = 26, t-value = 1.724, P = 0.086) and highest education (SP: $X^2 = 1.130$, df = 2, P = 0.568, DR: $X^2 = 0.555$, df = 2, P = 0.758). For each country, the most appropriate data gathering method was selected. In SP, digital questionnaire was launched in social media and existing contact lists by e-mail; however, some older respondents requested a paper version of the questionnaire and they received such version. In the DR, data were mainly collected using a paper version of the questionnaire, because of the relatively scant access to the digital questionnaire.

The questionnaire contained six blocks of questions. The first block of statements investigated the respondents´ perceptions related to insects as food: safe to eat (Dolgopolova et al., 2015), healthy (DeFoliart, 2010) and nutritious (van Huis, 2013), as well as the price, sustainability and taste of insects (House, 2016; Tilman & Clark, 2014) compared with the traditional meat. The second block of the questionnaire contained the ten (10) statements of the FNS developed by Pliner & Hobden (1992). Then, a block included six (6) statements of the Food Technology Neophobia Scale (FTNS) developed by Cox & Evans (2008). The fourth block of questions investigated peoples' claimed willingness to try and purchase insects as food. Finally, participants were asked to choose from four options in regards whether insects provide a realistic alternative to offset the growing demand of animal-based proteins. The options were: 1) No, it is all a fad; 2) Insects are a realistic alternative that is available now; 3) Not now, but perhaps as an intermediate-term consideration (2030); or 4) Not now, but perhaps as a long-term consideration (2050). The questionnaire also registered socio-demographics including gender, age and educational history (Verbeke, 2015). All the questions were presented in form of: i) options questions or ii) statements in which the respondents should express their opinion using a 5-point Likert scale anchored to strongly disagree=1 to strongly agree=5. Table 1 presents the socio-demographic profile of the sample with respect to the population of SP and the DR.

Table 1. Socio-demographic profile of the consumers' sample (401) expressed in percentage (%) of each sub-group and compared with Spain and the Dominican Republic population

Variable	Cases	% Sample SP (N=200)	%Spain (INE, 2017)	% Sample DR (N=201)	%D. Republic (ONE, 2015)
Gender	Male	50.5	51.0	47.3	48.6
	Female	47.0	49.0	51.2	51.4
	Prefer no answer	2.5		1.5	
Age	0-24 years	29.5	25.0	53.7	45.4
	25-54 years	54.0	45.3	38.3	39.5
	55-64 years	9.0	11.9	4.5	7.7
	65 or more years	7.5	17.8	3.5	7.4
Highest education	Primary	13.0	15.4	56.7	56.8
	Secondary	19.5	20.9	22.9	24.7
	University	67.5	63.7	20.4	18.5

Chi-squared values and *t*-value for each of the demographic data are: gender, SP: $X^2 = 0.049$, df = 1, $P = 0.824$, DR: $X^2 = 0.044$, df = 1, $P = 0.833$; age, Spain mean = 43, *t*-value = -1.604, $P = 0.110$, D.Republic mean = 26, *t*-value = 1.724, $P = 0.086$; Highest education, SP: $X^2 = 1.130$, df = 2, $P = 0.568$, DR: $X^2 = 0.555$, df = 2, $P = 0.758$.

In a first stage of the data analysis, a t-Student test was used to determine if SP and DR sub-groups were statistically significance from each other in the perception of insects as food, FNS and FTNS descriptors. In a second stage of the data analysis, a principal component analysis (PCA) was used to reduce the dimensions of the FNS and the FTNS to interpret the models and test the optimal number of determinant descriptors in the scales. The rotate graphic showed the descriptors that provide similar information to the model due to their close position. The reduction of dimensions avoids multicollinearity. The highest loads for each component corresponded to the selected predictor.

In a third stage of the data analysis two binary logistic regressions, in the SP and in the DR sub-groups, were developed to obtain the determinant factors to accept insects as food. In the binary logistic regression the log odds of the outcome were modelled as a linear combination of the descriptors. The dataset has a binary response (outcome, dependent) variable called 'accept insects', which is equal to 1 if the respondent answered 'yes' or 'maybe' willing to try insects as food and 0 otherwise.

Results and discussion

Try and buy insects as food

The willingness to try insects as food in the DR is low, with only 18.04% and a mere 7.26% willing to buy insects as food. The result predicts a low acceptance of insects as food in the DR because the intention to try is a strong predictor of the behaviour of eating insects (Sogari et al., 2019). Most of Dominicans (46.67%) dismissed insects as a realistic option as a food source, which was further accentuated by the fact that 82.72% of the Dominicans found all insects disgusting. The result confirms that insects disgust reduce the acceptance of insects as food. In this sense, it has been suggested that social learning plays a significant role in disgust (La Barbera et al., 2018). Moreover, Holm Jensen and Lieberoth (2019) added that disgust may be driven by social norms and the perception of insects as inappropriate for food dishes and distasteful (Tan et al., 2016). Moreover, in the DR it was found the lowest acceptance of insects as food in the current literature. The results in the DR confirm authors pointed out that population in less developed countries who do not consume insects appears to be the most critical and represents a proportionally larger part of the world population with around 4 billion, which could have the most to gain with the adoption of insects as food (van Huis, 2013) because many of people in developing countries have a diet with either a suboptimal caloric or protein intake. In contrast, in the Spanish sub-group one out of three respondents indicated willing to try insects as food, while 17.5% of respondents indicated a willingness to buy edible insects (Table 2). The results in SP are similar to other EU countries (Caparros Megido et al., 2014). Nevertheless, the result contrasts with the high acceptance of insects as food in USA (64.0%) (Ruby et al., 2015).

Table 2. Willingness to try and purchase insects as food and the realistic of the insects as food, expressed in percentage of respondents in Dominican Republic and Spain sub-groups

Variable	Cases	%Spain (N=200)	%D.Republic (N=201)
Try insects	Yes	34.50	18.04
	Maybe	32.50	18.04
	No	33.00	63.92
Buy insects	Yes	17.50	7.26
	Maybe	31.50	21.76
	No	51.00	70.98
Realistic	No, insects are a fad	29.50	46.67
	Yes, insects are available now	20.00	12.78
	Not now, maybe in 2030	24.00	15.00
	Not now, maybe in 2050	26.50	12.78
Insects opinion	All insects are disgusting	37.50	82.72
	I have a dislike some insects	37.50	13.09
	I do not mind insects	25.00	4.19

Consumer perception, FNS and FTNS descriptors

The t-test confirmed significant differences between SP and DR sub-groups in all but one of the FNS descriptors; they only coincided for the descriptor of constantly sampling new and different foods. The results reveal that Dominicans presented higher food neophobia than Spanish consumers. This result is in consonance with Sogari et al. (2019) who demonstrated that food neophobia is negatively correlated with the willingness to eat insects. Therefore, both food neophobia and insects disgust contribute to reduce the acceptance of insects as food in the DR (La Barbera et al. 2018). The result might be explained due to the strongly rooted food culture in the DR with respect to the Europeanize gastronomic culture of SP (Menozzi et al., 2017). In contrast, consumers in both countries coincided on food technology neophobia descriptors except in the belief that new food technologies decrease the natural quality of food and that the media usually provide a balanced view of new food technologies, which were significantly higher in the DR. The result might suggest a lower adoption of processed insect products (Castro Delgado et al., 2020) in the DR in consonance with the country development level (Tilman & Clark, 2014). SP consumers perceive insects as significantly ($P < 0.01$) more nutritious, safe to eat and healthy than DR consumers. Additionally, SP consumers find that insects are much more sustainable ($P < 0.01$) and cheaper (P < 0.05) than traditional meat with respect to DR consumers (Tilman & Clark, 2014) (Table 3). This result might be explained due to the European media coverage in the last years that present insects as an alternative and sustainable source of protein (Sogari, 2015).

Table 3. Mean and standard deviation (M±SD), means difference (SP-DR) and *t*-test significance (*t*-value and *P*) of sub-groups

	Spain (N=200)	D.Republic (N=201)	Spain-D.Republic	*t*-value
Perception of Insects as food				
Healthy	3.33(±0.97)	2.73(±1.14)	0.60	7.293**
Safe to eat	3.09(±0.99)	2.47(±1.07)	0.62	9.616**
Nutritious	3.49(±0.98)	2.75(±1.15)	0.74	4.450**
Much more sustainable than traditional meat	3.23(±1.05)	2.49(±1.19)	0.74	8.095**
Much tastier than traditional meat	2.30(±0.93)	2.12(±1.06)	0.18	0.453
Much cheaper than traditional meat	3.15(±1.02)	2.81(±1.16)	0.34	7.871*
FNS descriptors				
I am constantly sampling new and different foods	3.57(±0.93)	3.51(±0.98)	0.06	0.651
I do not trust new foods	2.25(±0.94)	2.62(±0.99)	-0.37	-3.870**
I like foods from different countries	4.10(±0.93)	3.71(±0.95)	0.39	4.203**
If I do not know what is in a food. I will not eat	2.10(±1.10)	2.80(±1.28)	-0.70	-5.860**
At dinner parties I will try a new food	4.37(±0.72)	4.10(±0.90)	0.27	3.261*
Some foods look too weird to eat	3.68(±1.01)	4.00(±1.02)	-0.32	-3.211*
I am afraid to eat things I have never had before	2.66(±1.32)	3.19(±1.26)	-0.53	-4.074**
I am very particular about foods I eat	2.47(±1.18)	3.33(±1.20)	-0.86	-7.275**
I will eat almost anything	3.68(±1.12)	3.45(±1.25)	0.23	1.980*
I like to try new foods from over the world	4.18(±0.91)	3.89(±0.98)	0.29	3.061*
FTNS descriptors				
The benefits of new food technologies are often grossly overstated	3.43(±0.98)	3.43(±1.10)	0.00	4.089
There are plenty tasty foods around so that we do not need to use new food technologies	2.95(±1.15)	3.17(±1.28)	-0.22	3.794
New food technologies decrease the natural quality of foods	3.11(±1.12)	3.81(±1.23)	-0.70	2.835**
The media usually provide a balanced and unbiased view of new food technologies	2.17(±0.92)	2.78(±1.19)	-0.61	18.655**
New products using new food technologies can help people have a balanced diet	3.36(±0.91)	3.49(±1.01)	-0.13	2.850
Innovations in food technology can help us produce foods in a sustainable manner	3.82(±0.96)	3.72(±0.95)	0.10	0.221

**P* < 0.05
***P* < 0.01

Reduction of descriptors

The rotated PCA for SP shows five latent variables, explained the 75% of the variance, for the FNS namely, 'Eat anything, low particular to foods and try new foods at dinner parties', 'Like ethnic foods', 'Like sampling new foods and low weird' 'Distrust on new foods' and 'Afraid to eat new foods'. The rotated PCA for the DR revealed five latent variables, that explained the 70% of the variance, from the FNS such, 'Eat anything, constantly sampling and try new foods at dinner parties', 'Like ethnics', 'Afraid new foods, particular about foods and to try new foods', 'Distrust new foods' and 'Weird new foods' (Table 4). Table 4 indicates the number corresponding to the principal component that showed the maximum load for each descriptor. Therefore, similar descriptors could be removed from the FNS to simplify the instrument. Results show that it is possible to drop 4-5 descriptors of the FNS. In a previous work Ritchey et al. (2003) reduced the descriptors and dropped two descriptors 'At dinner parties I will try a new food' and 'I will eat almost anything' arguing that some descriptors could drop from the original FNS what is confirmed in this research. Nevertheless, the Van Trijp and Steenkamp (1992) statement of eliminating the terminology of 'exotic foods' and 'food from other countries' from the FNS considering may no longer be relevant because of the greater incorporation of exotic or ethnic foods in modern society, is rejected in this context because the descriptor 'Like ethnic foods' resulted a component to consider in SP and the DR.

Table 4. Maximun loads corresponding to the Food Neophobia Scale descriptors in Spain and Dominican Republic, in a PCA for rotated components using varimax. The table indicates the number corresponding to the principal component that showed the maximum load for each descriptor.

	Spain		Dominican Republic	
Food Neophobia Scale descriptors	Component	Loads	Component	Loads
I am constantly sampling new and different foods	3	0.585	1	0.692
I do not trust new foods	4	-0.863	4	0.807
I like foods from different countries	2	0.881	2	0.896
If I do not know what is in a food. I will not eat	2	-0.559	3	0.503
At dinner parties I will try a new food	1	0.602	1	0.661
Some foods look too weird to eat	3	-0.804	5	0.953
I am afraid to eat things I have never had before	5	0.843	3	0.829
I am very particular about foods I eat	1	-0.786	3	0.679
I will eat almost anything	1	0.789	1	0.693
I like to try new foods from over the world	2	0.725	2	0.711

The SP rotated PCA reveals two latent variables for the FTNS explaining the 71% of the variance, namely, 'Benefits of new food technologies' (component 1) and 'Media unbiased view of new food technology' (component 2). The DR rotated PCA reveals three latent variables for the FTNS explaining the 71% of the variance, namely, 'No confidence new food technologies' (component 1), 'Sustainable and balanced diets of new food technologies' (component 2) and 'Media unbiased view of new food technology' (component 3) (Table 5).

Table 5. Eigenvalues in the principal component analysis (PCA) of the Food Technology Neophobia Scale variables in Spain and Dominican Republic sub-groups. Rotated components using varimax. The highest loads for each component corresponded to the selected predictor

	Components Spain		Components Dominican Republic		
FTNS descriptors	1	2	1	2	3
The benefits of new food technologies are often grossly overstated	0.468	0.134	0.808	0.263	-0.077
There are plenty tasty foods around so that we do not need to use new food technologies	0.695	0.291	0.634	-0.259	0.404
New food technologies decrease the natural quality of foods	0.645	0.289	0.686	-0.216	-0.113
The media usually provide a balanced and unbiased view of new food technologies	-0.219	0.886	-0.022	0.032	0.895
New products using new food technologies can help people have a balanced diet	-0.805	0.221	-0.105	0.650	0.566
Innovations in food technology can help us produce foods in a sustainable manner	-0.717	0.111	-0.037	0.904	-0.045

Models of acceptance of insects as food

The openness to 'eat almost anything' was a determinant issue for consumers in SP (Wald χ^2 = 14.630) to accept insects as food and to find 'some foods too weird to be eaten' was determinant to reject insects as food (Wald χ^2 = 6.780) (Dolgopolova et al., 2015). This result is in consonance with Sogari et al. (2019) who stated the perception of weird reduces the likelihood to accept edible insects. This effect could be mitigated with information about the edible insects. For Spanish consumers, openness to eat almost anything is significantly more likely to accept insects as food. A one-unit increase in the score of 'I will eat almost anything' is associated with a 28% increase in the likelihood of accepting insects as food in SP from an initial 50% of likelihood. No one descriptor of FTNS, in SP, was determinant for accepting insects as food.

Dominicans that afraid to eat things that they have never had before are significantly less likely to accept insects as food (Tilman & Clark, 2014). The result is in consonance with Sogari et al. (2019) who stated that fear of eating food never tried before reduces the likelihood to accept edible insects. In the DR, fear is determinant to reject insects as food. Moreover, the model in DR shows that consumers that believe that the new food technologies are overstated are more likely to accept insects as food (van Huis, 2013); a one-unit increase this belief is associated with a roughly 18% increase in the likelihood of being ready to accept insects as food from the initial 50% likelihood. Only this descriptor of FTNS, in DR, was determinant in both countries for accepting insects as food.

Table 6 presents the results of the binary logistic regression models with the estimated logistic regression coefficients (β), their respective standard errors (S.E.), Wald χ^2-statistics, significance levels, odds ratios (Exp(β)) and goodness-of-fit statistics.

Table 6. Coefficient estimates and diagnostics from binary logistic regression explaining consumers´ acceptance of insects as food in Spain (N=200) and the Dominican Republic (N=201)

Descriptors	β	S.E.	Wald	Sig.	Exp (β)
SP acceptance model					
Can eat almost anything	0.576	0.151	14.630	0.000	1.780
Some foods look too weird to eat	-0.522	0.200	6.780	0.009	0.594
DR acceptance model					
I am afraid to eat things I have never had before	-0.543	0.181	9.008	0.003	0.581
The benefits of new food technologies are often grossly overstated	0.363	0.182	3.959	0.047	1.437

Goodness-of-fit statistics of the model associated to acceptance of insects as food in SP: -2Log likelihood statistic=195.479; Cox and Snell R^2 =0.252; Nagelkerke R^2 = 0.351; Overall success rate=81.0%
Goodness-of-fit statistics of the model associated to acceptance of insects as food in DR: -2Log likelihood statistic=150.162; Cox and Snell R^2 =0.342; Nagelkerke R^2 = 0.47; Overall success rate=81.9%

The results demonstrate that Dominicans presented the highest food neophobia and the lowest acceptance of insects as food. Moreover, in the DR was found an accentuated attitude of insects disgust (Mancini et al., 2019). In DR, fear of eating food never tried before reduces the likelihood to accept edible insects, while in SP the lack of knowledge of entomophagy. Therefore, it is concluded that, in this context, to increase the acceptance of insects as food is needed to reduce disgust, food neophobia and fear toward edible insects whilst increase the knowledge of entomophagy. Firstly, communicate the control of insect treating facilities, insect preparation procedures, control of storage methods and distribution systems, potential allergenics (Yen, 2009) and the toxicological, microbial and hygienic safety of edible insects (Hartmann et al., 2015; McFadden & Malone, 2018) can increase the knowledge of entomophagy. Then, a successive exposure to insect-based products (Mancini et al., 2019; Sogari et al., 2019) along with continuous information with a long-term impact (Barsics et al., 2017) could increase acceptance of edible insects (Caparros Megido et al., 2014; Hartmann et al., 2015). Finally, tasty insect-based products embed in positive gastronomic experiences and paired with positive image and stimuli (La Barbera et al., 2018) can improve the acceptance of insects as food in these countries.

Conclusions

This study's findings reflect the differences in acceptance of insects as food in the DR and SP. The results reveal that Dominicans presented the lowest acceptance of insects as food with the higher food neophobia. The results confirm that population in less developed countries who do not consume insects appears to be the most critical, whilst due to their nutrition shortage, they could take an important advantage from this food. The research demonstrated that the significantly positive determinant descriptor for accepting insects as food in SP is the openness to eat almost anything, whilst in DR to overstate new food technologies. The models predict that a one-unit increase in consumers' openness to eat almost anything in SP is associated to a 28% increase the likelihood to accept insects as food. While, one-unit increase the beliefs on the benefits of new food technologies are overstated in the DR is associated to 18% increase the likelihood to accept insects as food. The research demonstrates that in SP, the predictors of rejection of insects as food is the lack of knowledge about entomophagy, whilst in the DR, it is the fear to eat foods that have never been tried before. Methodologically, this research confirms that 4-5 descriptors could be removed from the FNS it proves the need to maintain the descriptor ‘like to try food from all over the world’ and ‘I will eat almost anything’ for the usage of insects as food. The 3-4 descriptors could be removed from the FTNS for the usage of insects as food to use a shorter and simpler instrument for implementation of the Food Technology Neophobia Scale.

Limitations

A possible limitation of the present work could be that consumers´ acceptance of edible insects is determined by psychographic descriptors but we have not considered the individual attributes such as gender, age, educational status, level of knowledge of edible insects, etc. Additionally, in future researches it is necessary to investigate the role of the level of knowledge of entomophagy by consumers in their acceptance of insects as food.

Further research lines

There is scope for further research regarding the generalisation of the findings with respect to the majority of less developed countries. The development of other new food preparations and processes for edible insects is another future line of research that could increase entomophagy acceptance as well as the understanding of insects´ neophobia. From the marketplace, could be interesting to analyse the evolution of the rejection of insect-based food due to the unavailability and the price.

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Tables

Table 1. Socio-demographic profile of the consumers' sample (401) expressed in percentage (%) of each sub-group and compared with Spain and the Dominican Republic population.

Table 2. Willingness to try and purchase insects as food and the realistic of the insects as food, expressed in percentage of respondents in Dominican Republic and Spain sub-groups.

Table 3. Mean and standard deviation (M±SD), means difference (SP-DR) and t-test significance (t-value and P) of sub-groups.

Table 4. Maximun loads corresponding to the Food Neophobia Scale descriptors in Spain and Dominican Republic, in a PCA for rotated components using varimax. The

table indicates the number corresponding to the principal component that showed the maximum load for each descriptor.

Table 5. Eigenvalues in the principal component analysis (PCA) of the Food Technology Neophobia Scale variables in Spain and Dominican Republic sub-groups. Rotated components using varimax. The highest loads for each component corresponded to the selected predictor.

Table 6. Coefficient estimates and diagnostics from binary logistic regression explaining consumers´ acceptance of insects as food in Spain (N=200) and the Dominican Republic (N=201).