Information bias condemning radical food innovators?
The case of insect-based products in the Netherlands

Introduction

New food products and ingredients have been continuously under debate in the last two decades. Nutraceuticals and functional foods, genetically modified organisms (GMOs), nanotechnologies, irradiated foods are just few examples of radical food innovations which have created substantial concerns and controversy among food managers, consumers and policy makers (Sylvester et al. 2009; Rollin et al. 2011). Still, research and development on new food products and ingredients is expected to be one of the "hot frontiers" within the food innovation landscape.
Within this landscape, insect-based foods constitute an emerging food category. An unified and worldwide accepted classification of insect-based food products does not exist yet. To illustrate the European Novel Food Regulation (EC) 258/97 (ENFR) is still assessing the status of insect-based food products, basically "tolerating" commercialization in the European market of products in which insects are used as a whole (thus not processed or used as ingredients), while forbidding commercialization of processed insect-based ingredients or products. In general, insect-based foods can be defined as products that are prepared using insects. Within this category we have products where insects can be visualized, often presented as delicatessen or appetizers, or less visualized, but never completely processed and used as source of ingredients (mainly proteins and micro-ingredients).
The increased attention for this category of food products is due to raising concerns about downsizing meat-related consumption, especially in western society, and search for potential alternative sources of protein (meat-substitutes), to both enlarge and enrich the nutritional quality of human diets (Sileshi and Kenis 2010; Derkzen et al. 2011; Belluco et al. 2013; Hoek et al. 2013). However concerns related to the acceptability of those products for (western) consumers are also raising (Elzerman et al. 2013).
While acceptance at the societal level is lagging, the scientific community is increasingly looking at insects as an important potential source of nutrition and protein (Derkzen et al. 2011; Belluco et al. 2013). Insects form a sustainable source of proteins because of their energy-efficient metabolism and the potential to feed on (food) waste streams (Derkzen et al. 2011; Oonincx and de Boer 2012). Though approximately 1500-2000 species of insects and other invertebrates are consumed worldwide (Yen 2009), insects are still not regarded as food in Europe as well as in other western societies. Insects are not eaten and responses of disgust towards insects are common in developed countries in the northern hemisphere.
Similarly to all radical food innovations, the main issue is that the introduction of insect-based foods will not necessarily lead to acceptance or adoption by consumers per se (Ronteltap et al. 2007). Consumers often show unsupportive attitudes towards novel foods, thus associating more negative than positive attributes to radical food innovations (Rollin et al. 2011). More specifically consumer acceptance seems to be driven by risk-perceptions, especially associated to health related risks and technological uncertainties (Siegrist 2008). Moreover consumer acceptance of novel product is strongly influenced by the amount, type and source of information provided (Rollin et al. 2011).
From a consumer acceptance point of view, insect-based products seem to generate even more concerns than other radical food products. For example socio-cultural barriers, such as *food taboo*, as well as psychological barriers, such as *neophobia*, can be considered as main factors of rejection or, at least, of low-speed adoption (Fessler and Navarette 2003; Meyer-Rochow 2009). Thus resistance to accept insect-based foods can easily be re-enforced by

information bias provided by both regulators and business players. This can hamper business opportunities and "condemn" radical innovators to be unsuccessful. This risk is even more relevant in the food innovation landscape of the European Union (EU) because consumers, regulators and business players are particularly risk-averse, thus creating an environment less open to radical innovations if compared to other areas in the world (i.e. the US or Asia) (Borrás 2006; Wijnands et al. 2007; Bunte et al. 2011; Rollin et al. 2011).

In this paper we try to better understand the role of information on consumer acceptance of radically novel foods, using insect-based food products in the Netherlands as a case study within the EU. More specifically we test whether different information frames provided to consumers influence their preferences and willingness to pay.

There are several reasons to carry out this study: firstly, to our knowledge, no other study has been conducted to investigate the role of *information bias* on consumer's consumer willingness to pay (WTP) for insect-based food products. Second, insect-based food products are potentially challenging western food cultures therefore our results might contribute to understanding consumers reaction to information, and cultural-related aspects of those products is fundamental for their success in the market. Finally, the findings from this study will be useful to improve marketing and management strategies for radical food innovators in the EU and worldwide.

In our study, we have implemented a choice experiment using a sample of 122 Dutch consumers. We introduced three different information treatments: a first group of consumers who hasn't been treated with any specific information (baseline group); a second group of consumers who has been treated with "neutral" information about insect-based products, thus describing the main features of these products (treatment 1 group); finally a third group of consumers who has been treated with "positive frames" about insect-based products, thus emphasizing the environmental benefits of meat-substitutes (treatment 2 group). We also control for other factors potentially creating information bias such as the use of a logo and health claims (Grunert and Wills 2007). Moreover we control for the role of visualization of insect on the food products.

Our results suggest that even though visualization (thus disgust and taboo) is the more negatively impacting feature on consumer's WTP, information treatments also produce significant negative effect on consumers' evaluation, implying that communication frames may lead to even more severe rejection and prevent market introduction of radically novel food.

Consumers acceptance of insect-based products as radical food innovation

The raising interest for insect-based food products is related to the fast development and exploitation of new market segments for meat-alternatives (Hoek et al. 2013). In industrialized countries, meat production and consumption are considered one of the most relevant sources of health costs related to diabetes, cardiovascular disease and obesity, mainly due to over-consumption (UNFPA 2012; Oonincx and de Boer 2012; Hoek et al. 2013). Thus, there is increasing awareness in the scientific as well as in the business community to reduce meat consumption and find ways to develop large-scale based meat-alternative products. Particularly in the EU, a growing number of food scientists, entomologists, and business players believe that the answer to this issue is to change "westernized diet" and to include an alternative source of proteins such as insects (Oonincx and de Boer 2012; Veldkamp et al. 2012). Moreover, from a business perspective, insect-based products can represent a profitable venture due to the potentials of the meat-substitutes market (Elzerman et al. 2013).

However the main barrier to this trend is represented by western consumers (potential) concerns on insect-based foods. To a large extend consumers concerns to accept insect-based foods resemble issues of acceptance for many other radical food products (DeFoliart 1997; 1999; Derkzen et al. 2011). Scholars have emphasized that new food technologies, such as nutraceuticals and functional foods, GMOs, nanotechnologies or irradiated foods, are potentially challenging consumers decisions because perceived as risky and unknown (Rollin et al. 2013). More specifically previous studies highlight how consumer decision to accept a new food product is related to a number of factors, such as perceived costs/benefits; perceived risk and uncertainty, knowledge and source of information, perceived behavioral control and subjective norm (Ronteltap et al. 2007; Rollin et al. 2011). All those factors seem to play a role when it comes to analyze acceptance of insect-based food products. For example the nutritional benefits of insect consumption are still not clear from a scientific perspective, while risks and hazards are still persistent (Belluco et al. 2013).

Besides risks and hazards western consumers are concerned to accept insect-based food products from a cultural and psychological perspective too (Derkzen et al. 2011). For example in the EU, eating insects is mainly framed as related to niche and ethnic products, sometimes as alternative to meat or within health-seeking diets. Still the great majority of European consumers do not associate insects to food (Verkerk et al. 2007; Derkzen et al. 2011). This is reinforced by the fact that in many European social contexts, entomophagy is a *cultural taboo* (Derkzen et al 2011). Changing such a taboo is a slow process given that westernized societies are still reluctant to use insects, despite being a good source of animal protein (Yen 2009). Thus, the main attitude towards insects as (part of) food products in European societies is related to either fear or disgust (Verkerk et al. 2007; Derkzen et al. 2011), or curiosity (Yen 2009). In many European countries, insects are still perceived as a primitive food and the visualization of insects in a food product is associated with issue of deterioration, contamination and generally low quality (DeFoliart 1999).

In this context information biases can play an important role, potentially reinforcing issues of risk, uncertainty and eventually rejection. This is because consumer acceptance of novel product is strongly influenced by the amount, type and source of information provided (Rollin et al. 2011).

Insect-based food industry in the Netherlands

Insect-based foods can be marketed in the EU only if not processed. If processed they are considered “novel foods” by ENFR, thus requiring a full pre-market assessment procedure (Belluco et al. 2013). The EU commission has started an update of the ENFR in 2012, in order to clarify the “legal status” of insect-based food products[1]. At this stage, insects can be marketed in the EU as whole, for both human and animal consumption, but they cannot be processed and used as ingredients in food products (e.g., as source of proteins or micro-nutrients) (Belluco et al. 2013). However, the use of insects as whole may not be advantageous to producers since this would mean that whole insects can be visualized on food products, thus creating several concerns among the business community about high risk of consumer rejection due to disgust and/or neo-phobia. This is indeed not helping the industry to take off and the entrepreneurs and investors to fully exploit opportunities of researching, developing and marketing insect-based products.

Besides these regulatory constrains the insect-based food industry already represents a reality in the EU and more specifically in the Netherlands. In this country many insect breeders are already operating, working in the feed and food sector, and the first European producer

[1] At the time we are writing this paper, no such update has been put in place yet.

organization (Venik) has been established (http://www.venik.nl/site/?lang=nl). Since its foundation in 2008, Venik is actively working on mitigating potential barriers for the acceptance of insect-based food products in the Netherlands and in the EU. Venik is also operating in the sector of feed and *pharma*, supporting research about nutritional features of insect-based food products and engaging in networking activities with NGOs and other stakeholders.
The Dutch government is also supporting researchers with grants concerning issues of legislation for governing insect farms, health and safety standards, and marketing through retail outlets. Insects as food products have been on the national news many times since the 2008 (http://www.venik.nl/index.php?res=high). In the Netherlands it is possible to find restaurants serving insect-based foods.
Therefore the Netherlands represents an ideal setting to start performing field research on insect-based food products, because the EU-wide regulatory vacuum has not discouraged entrepreneurs, researchers and public authorities to invest in this domain.

Methodology

Attributes and Choice Experiment design

Choice Experiment (CE) is the most widely used stated preference multi-attribute method in valuing products or attributes. In CE, respondents are asked to examine a sequence of designed choice tasks. In each choice task, consumers are asked to choice between alternatives described by a selected number of product profiles, each of them is described in terms of attributes with different levels (Louviere at al. 2000). Some of the reasons for CE's popularity include its flexibility to take into account several attributes which can be estimated simultaneously and its consistency with random utility theory and Lancaster's consumer theory.
We implemented a choice experiment with consumers in the Netherlands in the cities of Wageningen, Utrecht and Den Bosch during December 2011-March 2012. As said the Netherlands is an ideal setting because it is a frontrunner country in this specific business. We randomly recruited 122 participants in different locations across the cities using a sampling procedure (by age and gender). The product we used in our study is an insect-based product that looks like a sushi, which is usually eaten in some Dutch restaurants and that has been "advertised" through the national media (http://www.venik.nl/index.php?res=high) (see Annex 1). Therefore it represents the most potentially familiar insect-based product to the Dutch consumers.
For this product, we identified four attributes: the first attribute refers to the price of the product, with four different levels (1.50, 2.50, 3.50 and 4.50 euros) for 4 sushi pieces. The first price level represents the base price, which reflects the average market price for an insect sushi box in a retailer shop in the Netherlands. The other price levels reflect possible premium price associated with those products.
The second attribute is related to product design which is capturing the role of legislation. Because EU legislation is "imposing" use of insects as a whole in the insect-based foods, we emphasize the role of visualization to assess whether the current legislation is affecting consumers' WTP. A positive contribution will mean that the visualization of insect as a whole is not hampering the potential capacity of this product to be appreciated by consumers and their WTP for this attribute. However we expect a negative impact due to visualization because it has been clearly considered as a strong element in determining issue of disgust (cultural-driven) or neophobia (psychological-driven) (Derkzen et al. 2011). To fully assess the role of visualization we used two alternative product designs, one in which the insect is

clearly visible, and an alternative design where the insect is not visible but used in the form of processed meat (see Annex 1).
The third attribute refers to the logo which is named "*Chrysalide*" and it is representing a stylized butterfly chrysalides. In many studies the use of food logos has been indicated as a relevant attribute for conditioning consumer choice and WTP, for example increasing the quality perception of the product (Golan et al. 2001; Grunert and Wills 2007, Gao and Schroeder 2009). Therefore we used a logo as third attribute with a clear reference to insects.
Finally, the fourth attribute is a nutritional claim because it refers to the content of Omega 3 in the product. We decide to include this attribute because this (micro-)nutrient is considered as one of the most promising nutritional features of insect-based food products.
Given the four attributes and its levels, in order to build our choice design, an orthogonal main effect plan was calculated using the SPSS *orthoplan*, which generated 8 profiles of product in option A. Then, given these 8 profiles, we use the generators derived from the suggested difference vector (1 1 1 1) by Street and Burgess (2007) for 4 attributes with 4, 2, 2 and 2 levels, respectively, and the two options to obtain the 8 profiles for the second option B. Hence, we obtained 8 pairs (which constitute our choice set) being this design 97.2% D-efficient compared to the optimal design. Participants were asked to answer a series of choices questions (i.e. choice tasks). Each respondent was asked to make choices in the 8 choice tasks. Each choice task consisted in three alternatives and consumers had to choose among them. To illustrate, the first two alternatives (option A and option B) are described by a selected number of product profiles, each of which is described in terms of attributes with different levels. The third alternative (option C) is the no-buy option used just in case individuals choose not to pick either of the two option A and B for each choice task.

Treatments' description and hypothesis testing

Our main objective is to investigate whether different information frames influence consumer's WTPs for insect-based products. Therefore, we designed a between-subject design where each respondent participated only in one of the treatments. In the first baseline treatment (BL), no information on insect-based products was provided to respondents before asking them to respond to the choice questions (tasks). However, in the second treatment (NE) neutral information on the use of insects in other part of the world indicating that eating insects is not common in the western countries but elsewhere was provided to individuals (see Annex 1). Finally, the third information treatment (PO), consists in a positive frame about the positive social and environmental impacts of scaling up insect consumption as meat-substitutes (see Annex 1).
In order to achieve the objective of our study, (whether consumers exposed to neutral or positive information frame on consumption of insect-based products showed higher WTP for them), we test two hypotheses.
The first null hypothesis is whether the WTP for the different insect-based products stated by those consumers who did not receive any frame information (BE) are equal to the WTP for the different insect-based products stated by those consumers who received neutral information (NE):

$$H0_1:(WTP^{NE}-WTP^{BL})=0 \qquad H1_1: (WTP^{NE}-WTP^{BL})>0 \qquad (1)$$

Likewise, the second null hypothesis is whether the WTP for the different insect-based products stated by those consumers who did not receive any frame information (BE) are equal to the WTP for the different insect-based products stated by those consumers who received positive information (PO):

$H0_2$: $(WTP^{PO} - WTP^{BL}) = 0$ $H1_2$: $(WTP^{PO} - WTP^{BL}) > 0$ (2)

If we reject the first hypothesis it means that neutral information on insect could drive consumers to pay more for these products. Moreover, if we reject the second hypothesis, we can confirm that providing more positive information to consumers drive them to have a higher WTP for these products.

Model specification

To assess consumers´ preferences for insect-based products, we consider the utility function derivate by Lancastrian Theory (Lancaster, 1966) and assuming a linear random utility function defined by:

$$U_{njt} = nobuy + b_1 Price_{ijt} + b_2 Visual_{ijt} + b_3 Logo_{ijt} + b_4 Claim_{ijt} + \varepsilon_{ijt} \quad (3)$$

where "nobuy" is the alternative specific constant coded as a dummy variable that takes the value 1 for the no-buy option and 0 otherwise. It is expected that the constant "nobuy" is negative and significant, indicating that consumers obtain lower utility from the no-buy option than from the designed alternatives (A and B). "$Price_{ij}$" is the price attribute of alternative j for subject i, while the rest of attributes "Visual", "Logo" and "Claim" are dummy variables which takes the value 1 if the corresponding attribute was present in the alternative A or B, and 0 otherwise. Finally, ε_{ijt} is a stochastic disturbance of alternative j for subject i distributed following an extreme value type I (Gumbel) distribution, i.i.d. over alternatives and is independent of attributes that is known by the individual but unobserved and random from the researcher's perspective.
Consumers are assumed to choose the alternative which provides the highest utility level from those available. Following other studies (Lusk and Schoroeder 2004; Tonsor and Shupp 2011), we estimated the Random Parameter Logit Model (RPL) (Train 2003) where the non-monetary variables (VISUAL, LOGO and CLAIM) were random following a normal distribution and individuals can differ from each other in terms of intensity of taste. Following Layton and Brown (2000) and Revelt and Train (1998), we also assume that the price coefficient is invariant across the individuals. Moreover, because we are using different samples (treatments), it is important to investigate if differences in parameter estimates across treatments are indeed due to the underlying preferences or to differences in variance. Hence, we tested if estimates insect attributes from the RPL are equivalent across the three treatments. Therefore, we pooled the data in one model by specifying an extended utility with the appropriate set of treatment dummy variables :

$$\begin{aligned} U_{njt} = {} & nobuy + b_1 Price_{ijt} + b_2 Visual_{ijt} + b_3 Logo_{ijt} + b_4 Claim_{ijt} + b_5 (Price_{ijt} \times dtreat_{NE}) + b_5 (Price_{ijt} \times dtreat_{PO}) + \\ & + b_6 (Visual_{ijt} \times dtreat_{NE}) + b_7 (Visual_{ijt} \times dtreat_{PO}) + b_8 (Logo_{ijt} \times dtreat_{NE}) + b_9 (Logo_{ijt} \times dtreat_{PO}) + \\ & + b_{10} (Claim_{ijt} \times dtreat_{NE}) + b_{11} (Claim_{ijt} \times dtreat_{PO}) + \varepsilon_{ijt} \end{aligned} \quad (4)$$

where $dtreat_{NE}$ and $dtreat_{PO}$ are coded as 1 for the neutral (NE) and positive (PO) treatment, respectively and 0 otherwise. The significance of the estimated b_5, b_6, b_7, b_8, b_9, b_{10}, and b_{11}, and their signs will enable us to test differences in attribute coefficients between neutral (NE) and positive (PO) treatments and baseline treatment (BE) in the hypothesis to be analyzed. To do this, we can use the z-test on the coefficient estimate. If the coefficients are statistically

different from zero at 5% level, it means statistically difference in preferences for insect-based attributes exists between neutral and positive treatment with the baseline treatment.
We estimated the model using Nlogit5 software.

Results

In table 1, the results of the chi-square tests of the socio-demographic variables across the three treatments are presented. Findings suggest that the null hypothesis of equality between the socio-demographic characteristics across the three treatment samples cannot be rejected at the 5% significance level for gender (chi-square= 0.178; *p-value* = 0.91), age (chi-square=3.017; *p-value*=0.807), education (chi-square=3.604; *p-value* = 0.1.65) and income (chi-square= 0.543; *p-value* = 0.762). Therefore, we can conclude that our randomization was relatively successful in equalizing the characteristics of participants across the treatments. Moreover we can notice that most of the participants were female (around 51%) and around 60% of participants had university studies. Moreover, most of participants belonged to range age between 18-35 years and about 16% of the participants had a net monthly income higher than 3,500 €.

Table 1. Definition and Average values of Demographic Variables (%)

Variable definition	Name (type)	BL	NE	PO
Number of participants		45	31	36
Gender				
Male	FEMALE (dummy	48.9	48.4	44.4
Female	1=female; 0 otherwise)	51.1	51.6	55.6
Age (years)				
	Between 18-35 years	46.7	58	50.0
	Between 35-54 years	17.8	6.4	16.7
	Between 55-64 years	28.9	29	30.6
	More than 64 years	6.7	6.5	2.7
Education of respondent				
High School	HIGHSCHOOL (dummy 1=high school; 0 otherwise)	57.8	54.8	75
Income				
High income	HINCOME (dummy 1= more than 3,500 €; 0 otherwise)	15.6	12.9	19.4

Table 2 reports the mean coefficient estimates of pooled model of three treatments. Firstly, it can be noticed that the price variable is negative and statistically significant in accordance with economic theory. Moreover, the rest of estimated mean values are statistically significant different from zero at 5% level. To illustrate VISUAL estimate coefficient is negative and statistically significant at 1% significance level, indicating that consumers had lower utility when an insect was showed on the food product. Moreover, LOGO estimate coefficient is positive and statistically significant, implying that consumers gained higher utility when a logo is indicated the existence of insects in their products. In the same way, CLAIM estimate coefficient is statistically significant and with a positive sign, suggesting that consumers' utility was positive when a nutritional claim on OMEGA 3 is present in the product. Finally, the standard deviation parameter estimates are statistically significant, meaning that heterogeneity around the mean of the random parameters indeed existed.

Table 2. Random Parameter model estimates and WTPs.

	Coeff. (z-value)
NOBUY	-1.626 (0.000)
PRICE	-0.636 (0.000)
VISUAL	-3.377 (0.000)
LOGO	1.106 (0.003)
CLAIM	1.181 (0.002)
Standard Deviation	
VISUAL	4.330 (0.000)
LOGO	1.591 (0.000)
CLAIM	1.787 (0.000)
N. obs.	2,688
Log-likelihood	-692.98

Table 3 reports the estimated parameters and the corresponding z-values for the dummy treatment variables to test our hypotheses[2]. Firstly, we notice that none of estimated coefficients of dummy treatment variables interacted with attributes variables are statistically different from zero at 5% level. According to our results, we can confirm that our first ($H0_1$:(WTP^{NE} –WTP^{BL})=0; $H1_1$: (WTP^{NE} –WTP^{BL})>0) and second $H0_2$: (WTP^{PO} –WTP^{BL}) =0; $H1_2$: (WTP^{PO} –WTP^{BL})>0) hypotheses of equality are failed to be rejected for the three analyzed attributes (i.e., VISUAL, LOGO and CLAIM), thus confirming that the preferences and the WTPs in the information treatments (NEU and PO) are not statistically different from our baseline treatment (BL).

These results suggest that even if consumers were framed both neutral or positive information about the consequences of consumption of insect-based products, their WTPs for insect-based attributes were not statistically different from those ones who did not receive any kind of information about the insect

[2] The total number of observations of pooled data set is equal to the total number of participant multiplied for the number of choice tasks (eight) and number of alternative in each choice task (three: option A, B, and C)

Table 3. Random Parameter model estimates and hypothesis testing

	Coeff. (z-value)
$PRICE \times dtreat_{NE}$	-0.077 (0.470)
$PRICE \times dtreat_{NE}$	-0.024 (0.817)
$VISUAL \times dtreat_{NE}$	-1.318 (0.268)
$VISUAL \times dtreat_{PO}$	0.302 (0.790)
$LOGO \times dtreat_{NE}$	-0.023 (0.964)
$LOGO \times dtreat_{PO}$	-0.192 (0.706)
$CLAIM \times dtreat_{NE}$	-0.109 (0.850)
$CLAIM \times dtreat_{NE}$	-0.474(0.424)

Finally, we also calculated the WTP values for the pooled model. Because the non-monetary attributes are dummy variables with two levels, the mean WTP values for individual attributes are calculated by taking the ratio of the mean parameter estimated for the non-monetary attributes to the mean price parameter multiplied by minus one. Table 4 reports the mean and the t-values of WTPs for different insect-based products. Results generally indicate that consumers were willing to pay a premium price of 1.31€ for a box of 4 sushi insect-based products when the logo "Chrysalide" is shown; and they were willing to pay 1.55€ more for a box of 4 sushi insect-based products when they knew that the product contained Omega 3. In contrast, consumers were willing to pay 7.40€ less (thus they were willing to be compensated) for the products with visualization of the insect.

Table 4. WTPs for different attributes of insect-based products

Population mean WTP $-(\beta_{attribute} / \beta_{price})$ (€/4 sushi pieces)

	BL+NE+PO treatment	BL treatment	NE treatment	PO treatment
VISUAL	-7.408 € (-6.73)	-6.16 € (-2.66)	-6.95 € (-3.47)	-7.84 € (-3.02)
LOGO	1.315 € (4.26)	1.58 € (2.82)	0.88 € (2.85)	1.43 € (1.38)
CLAIM	1.558 € (4.64)	1.83 € (3.40)	1.24 € (2.47)	1.68 € (1.82)

Discussion and concluding remarks

This study investigates the role of information bias on consumer acceptance and WTP for an emerging category of radical food innovation in the EU context such as insect-based products in Netherlands. Because food products with processed insects are not allowed by European legislators, food players are forced to sell these products with a specific design, thus using non processed insects and usually having the insects clearly visible on product. As showed by our study this is undermining the possibility of business actors to increase the value-added of these products, while increasing the risk of consumers' rejection. An intensive use of positive frames associated to social and environmental benefits of consumption of insect-based foods is not significantly impacting the WTP of interviewed consumers. This result suggest that the negative effects of visualization is difficult to mitigate and represent a serious threat for future success of any marketing strategy.

From a managerial point of view this study has highlighted how sensitive radical innovations in the food sector can be to issues related to cultural barriers and information treatments. This seems to have a relevant impact on the type of marketing strategy to implement. In this sense the insect-based niche seems to be characterized by two polarized approaches: on one hand, we have companies that are heavily using visualization as a fundamental element of their marketing strategy because they intentionally want to position their insect-based products as "ethnic" or "eccentric" foods. On the other hand, we have other companies that are trying to frame insect-based foods as "normal" foods, thus trying to position them within the growing segment of protein-substitutes and meat-alternatives. While the first group of companies is more looking at premium products, the second is more keen on working towards "large volumes", thus implementing strategy for mass-production and economies of scale. Our results indicate that the actual EU legislation will "impose" visualization, the second type of radical innovators is more likely condemned to be unsuccessful.

Thus from a policy making perspective this study highlight the urge for a clear plan of actions from the EU Commission. A first step should be to clarify whether insect-based food should be considered as a novel food. Accordingly the second step should be to identify the main conditions, and an effective timeline to let insect-based food be a suitable product to compete in the meat-alternative markets.

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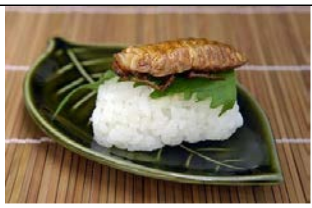
Annex 1

Choice Experiment:
You are about to participate in a study designed to understand how people like you value a variety of different insect-based food products (meat) sold in different supermarket.

Short explanation:

1. The food product we focus on can be consumed as appetizer or part of the main meal. Please realize that both products are insect-based!
2. The price of the product is based on a package of 4 pieces.
3. The logo states that the product has a certification and is free of diseases and can be eaten safely.
4. Omega 3 is a fatty acid that prevents from cardiovascular diseases and enhances the immune system. Therefore, it is clearly stated when the product contains Omega 3.

Which alternative do you prefer?

Product A	Product B	Answer options
 **Price: € 1,50 per 4 pieces**	 Chrysalide **Contains:** **Omega 3 (essential fatty acids that prevent from cardiovascular diseases and enhance the immune system)** **Price: € 2,50 per 4 pieces**	Product A Or Product B Or Neither

Treatment NE: About 1,400 species of insects are edible to man, and insects form a common food source for 80% of the world's population. Also, in Europe insects are already used as food and directly consumed, for example as delicatessen or appetizers, while potentially suitable for being incorporating as processed foods, or be used as a basic ingredient such as sugar or flour.

Treatment PO: As the world population is growing and increasingly urbanising, the question of how to feed the world is becoming critical. Meat consumption is increasingly the focal point in the debate about worldwide environmental degradation, food security in developing countries and health costs in developed countries. Examples are the environmental degradation of subtropical and tropical forests related to fodder production for the western livestock industry, problems of embedded water in agriculture especially in meat-related products, health problems such as obesity, diabetes and elevated cholesterol, and in developing countries, inadequate access to food, which is threatening the livelihoods of billions of poor households. New sources of proteins are increasingly needed and already pursued by many food companies. Insects are a good example of an alternative and a sustainable source of proteins. About 1,400 species of insects are edible to man, and insects form a common food source for 80% of the world's population. Also in Europe insects are already used as food and directly consumed, for example as delicatessen or appetizers, while potentially suitable for being incorporating as processed foods, or as a basic ingredient such as sugar or flour.