

A CASE STUDY OF AN ALTERNATE SOURCE OF PROTEIN: WHAT DO THE CONSUMERS THINK ABOUT ENTOMOPHAGY?

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Abstract: *Consuming insects can be the solution for providing food security all around the globe in the future. It is a widely accepted fact, that the Earth's population will exceed 9.5 billion in 2050. To be able to feed that many people, the current volume of food production needs to be doubled, therefore we need to (re)discover new basic food sources. Insects are consumed on nearly all continents excluding Europe. The aim of the research is, to sum up, the challenges and opportunities of entomophagy in Europe and to evaluate the consumer's willingness to try out these insect-based food products. An online survey was edited, which was filled out by 158 respondents. The socio-demographic aspects were gender, place of living, age, qualification and hours of exercise per week. The database was evaluated with descriptive statistical methods and non-parametric procedures. The results show that the biggest obstacle ahead of the insect-based products to be widely consumed is the European consumer itself. The „yuck-factor” means that there are some deeply rooted cultural differences between the European and other cultures. Nearly all of the respondents heard about insects as a food ingredient. 45% of them would taste an insect based dish. Males have significantly higher willingness to try out these insect-based products, however, no other socio-demographic group played role in determining the faction. In conclusion, until the conventional food products price does not raise significantly compare to the average salaries, consuming insects in Europe will not be a common thing. In the meantime, the goal should be to introduce these innovative food sources like insects to the consumers. The positive changes in the EU and Switzerland's regulation can be an empowering factor in the continent. All in all, it is too early to widely introduce an innovation like this into the market, but there are few segments where the consumers are more likely to adopt edible insects into their diet.*

Keywords: *entomophagy; edible insects; food neophobia; alternative protein sources; consumers' attitude.*

JEL classification: *Q13; M31; O52.*

1. Introduction

According to UN Population Division's forecast, Earth will have to feed approximately 9.7 billion people in 2050. Nowadays, nearly 1 billion people starving due to food security reasons. Due to these reasons, we have to think again about food production and its efficiency to waste less during the process. New food production technologies must be made. Insects offer an opportunity to mold our modern technologies and scientific knowledge to give entomophagy a new perspective. Consuming insects can be examined from many sides including physiological, economic, environmental and psychological. To talk about the advantages, insects are a healthy and rich in nutrients alternatives to the conventional food products. According to Rumpold and Schlüter (2013) study who examined 236 species, insects provide satisfactory amounts of energy, protein, micronutrients, amino acid requirements for human needs. Livestock rearing is responsible for 18% share of GHG emissions in CO₂ equivalent, which is a higher share than the transport sector produces. Nitrous oxide and methane are mainly responsible for the emissions in livestock rear. Beef

cattle rearing produces around 2800 gram GHG per kg mass gain, however, mealworms or locusts GHG production per kg mass gain is nearly zero (Oonincx et al., 2010). These results should be considered with caution because the tests were performed in laboratory. Rumpold and Schlüter (2013) discovered, that there are many factors, which determines the insect's protein amount. Species, feed, stage of the metamorphosis, place of living and the measurement system of the research have its role to determine the calculated amount of protein in insects. One of the biggest obstacle ahead of entomophagy is the consumer's misbeliefs. They have a negative attitude towards insects, which stages a big challenge for developers.

To help the development of the industry, the European Parliament agreed on a new regulation (Regulation EU 2015/2283) on novel foods in November 2015. It states, that insect-based foods were not widely consumed in the EU before May 1997 (Regulation (EC) No. 259/97), so that is why insect-based products require a pre-market authorisation. Producers are obliged to submit an application for authorization to the European Commission by 2nd of January 2020 (Laaninen, 2016). A similar law will be applied from 1st of May 2017 in Switzerland. Coop supermarket chain and the start-up firm Essento have already agreed on to develop insect-based products to the market.

In the past few years, studies about entomophagy are based on the consumer's attitude. Verbeke's (2015) study showed the Belgian consumers readiness to adapt insects into their diet. He measured among other things their neophobia, importance of tastiness and the opinion about the food production's impact on the environment. The results showed, that the Belgian consumers are not ready to adapt insects into their diet, however, he identified a group of young men, who are willing to try these innovative food products and have a low neophobia value. Gere et al. (2017) examined the Hungarian consumers with a similar survey to Verbeke's. They found that males are more ready to eat insects and the food neophobia is a barrier for consumption of insects, however, low food technology neophobia values were seen which gives opportunities for the food industry. Verneau et al. (2016) states that the acceptance of entomophagy depends on the country's gastro-culture. The Danish consumer's willingness of try out were significantly higher than the Italian consumer's. The reason behind this could be the stronger Italian gastro-culture, which tolerates less the unusual food products. Piha et al., (2016) ended with the same result: the Northern Europeans are more willing to accept insects as an alternative protein source than the Central Europeans. Le Goff and Delarue's (2017) study contains the result of flavoured chips try out which was labeled as insect flavored. One hundred people took part in the research and their emotions before and during the try-out were recorded. The footages showed the differences in the consumer's attitude. The participants rejected the idea of tasting an insect-based food product, however, after the first bite, most of them showed signs which meant that they are into accept the product.

2. Materials and Methods

In the following paragraphs, we would like to present the collected materials and used statistical methods of the case study.

2.1. Methods of sampling and interviewing

The research includes a primer and secondary data source. For the first, an online survey was edited to measure the knowledge of the participants about entomophagy. Altogether 158 replies were received between 29. July – 19. August 2016. The number and quality of the respondents do not make the research representative to any group, however, at the time there was not done any representative research about the topic in Hungary. Therefore the results are only informative. The items of the survey are about the idea of consuming an insect and their knowledge about entomophagy around the world. The main question of the study is, that the respondents are opened enough to take the insects into their diet.

Five grouping variables were made which are the following: gender, age, qualification, place of living and hours of exercise per week. The results are visualized in Table 1.

Table 1: The sample's demographic factors

Demographic factors	Total Sample (n=158) (%)
Gender	
Female	69.60
Male	30.40
Age	
16-22	15.80
23-30	29.70
31-50	38.00
above 51	16.50
Qualification	
Elementary	2.50
Technical college	2.50
High school	32.30
Higher degree	62.70
Place of living	
Village	12.70
City	24.70
County town	50.60
Capital city	12.00
Exercise per week	
between 0-2 hours	43.70
between 3-5 hours	37.30
between 6-8 hours	10.10
above 8 hours	8.90

Source: Own collection of data, 2016

The secondary data sources are based on the FAO's food security conference, which was held in Rome 2012 and previous studies in the topic of entomophagy.

2.2. Applied methods for data evaluations

The data from the survey was analyzed with IBM SPSS Statistics 23.0. statistical software. The items were measured with Likert- and nominal scales. The latter was analyzed with Pearson's Chi-square test and Phi and Cramer's V. To evaluate the Likert-scale items, we used the one sample Kolmogorov-Smirnov test to determine the sample's distribution. It was not normally distributed ($p < 0.001$). Therefore we used nonparametric tests (Mann-Whitney, Kruskal-Wallis) to analyze the differences between the items and the grouping values.

3. Results

The results of the research will be showed in this section. Firstly, the results of the related knowledge questions, then the related questions to edible insect consumption.

3.1. Results of the related knowledge questions

3.1.1. Do you know that insects are consumed around the world at daily basis?

99.4 percents of the respondents (only excluding one) said that they know that the insects are suitable for human consumption. However, only 96 people (60.8%) knew the correct

definition of the listed possibilities of consuming an insect. We compared the two groups each (who knew the definition and who did not) with the grouping variables with Chi-square test which did not result in any significant ($p=0.14$) differences.

3.1.2. Citizens of 80% of the countries around the world are consuming insects' part of their diet, however, it is not common in the western European countries. Which are three of the following possibilities most likely the reason?

The respondents had to choose three out of the seven possibilities. Due to a system error, two of them chose only two answers. Table 2 shows the reasons for rejection.

Table 2: Reasons for rejection of entomophagy

Choices	Number of choices (count)	Percentages (%)
Cultural differences	137	29.03
We identify the insects with causing damages and health issues	101	21.40
From European's point of view, consuming insects is a primitive way of eating	92	19.49
Displeasing appearance and presentation	77	16.31
Doubts about food safety	45	9.53
Better weather conditions in the tropical zone	13	2.75
Low nutritional value	7	1.48
All	472	100.00

Source: Own collection of data, 2016

According to the respondents, cultural differences is the biggest obstacle ahead of entomophagy to be a conventional food protein in Europe (29.03%). Moreover, they identify the insects as a being the cause of damages (mainly in agriculture) and health issues (21.40%). Thirdly, from their point of view consuming insects is a primitive way of eating (19.49%) which connects to the cultural differences. On the other hand, they know, that the insects have a high nutritional value and only 45 of them (28% of the respondents) has doubts about its safety. The three most chosen answers were put under a Chi-square test to see if there is a difference in any grouping variables from the expected numbers. There was not any significant connection between the measured and the expected values ($p=0.512$).

3.1.3. Consuming insects has many advantages. Mark two of the most significant from the list below.

Five answers were available for the respondents. High nutritional value (32%), environmentally friendly production (31%) and low retail price (26%) were the most chosen answers. The third place of the low retail price shows that most of them do not have relevant information about the insect-based products retail price. Crosstabs were edited between the top three answers and the grouping values and we found one significant difference between a groupings values (Table 3).

Table 3: The result of Pearson's Chi-square test between the matter of low price and place of living

Name of the items			Place of living				All
			Village	City	County town	Capital city	
Low price	No	N (count)	15	15	35	11	76
		% within place of living	75.0	38.5	43.8	57.9	48,1
	Yes	N (count)	5	24	45	8	82
		% within place of living	25.0	61.5	56.3	42.1	51,9
All		N (count)	20	39	80	19	158
		% within place of living	100,0	100.0	100.0	100.0	100.0

Source: Own collection of data, 2016

According to the test's result ($p=0.035$), for respondents living in the „City” or „County town” more likely to matter the low price than the people who live in a „Village” or in the „Capital city”. However, the strength of the connection is weak due to the 0.233 value of the Phi and Cramer's V.

3.2. Results of the related questions to edible insect consumption

3.2.1. Did you taste any insect-based dish?

Only 8% percent of the respondents tasted an insect-based dish before. 53% percent of them are between ages 31-50. No significant connection was found with Chi-square test with any grouping variable.

3.2.2. Would you try an insect-based dish?

Four possibilities were available: never, only to avoid starving, I may try, I would like to try. 55% percent of the respondents would not try it (never and only to avoid starving answers combined). Differences between the grouping values were evaluated and were found one connection (Table 4).

Table 4: Connection between the willingness of try out and gender

			Gender		All
			Male	Female	
Would you try an insect based dish?	Never	N (Count)	8	32	40
		% within gender	16.7	29.1	25.3
		Residual value	-1.7	1.7	-
	Only to avoid starving	N (Count)	9	40	49
		% within gender	18.8	36.4	31.0
		Residual value	-2.2	2.2	-
	I may try it	N (Count)	21	31	52
		% within gender	43.8	28.2	32.9
		Residual value	1.9	-1.9	-
	I would like to try it	N (Count)	10	7	17
		% within gender	20.8	6.4	10.8
		Residual value	2.7	-2.7	-
All		N (Count)	48	110	158
		% within gender	100.0	100.0	100.0

Source: Own collection of data, 2016

Men are more likely to taste ($p < 0.01$) insect-based dish than women, however, the connection is semi-moderate (Phi and Cramer's V is 0.301). The result in Table 5 confirms it even more.

Table 5: The Mann-Whitney test's result of „Would you try an insect based dish?“ question connected with gender

Name of the item	Gender	N (Count)	Mean rank
Would you try an insect based dish?	Male	48	97.39
	Female	110	71.70
	All	158	-

Mann-Whitney rank test, $p < 0.05$

Source: Own collection of data, 2016

Further investigation was done inside the male group, however, the age, qualification, place of living or the hours of exercise had not affected any differences either.

3.2.3. In your opinion, which group can be persuaded to consume insects?

The respondents had to name one group (children, students/young adults, adults, and elderly, none of the above) which can be persuaded to consume insects in their opinion. The most likely to persuaded group is students/young adults (45%) and the children (31%). Most of the respondents think people in the younger age groups are more willing to try an innovative protein. However, the students/young adults group (age between 16-30) would not like to try (61.2%) an insect-based dish.

4. In conclusion

The goal of the study was to analyze the status of entomophagy in Hungary with quantitative statistical methods. Nearly all of the respondents had heard about the fact, that some of the insects are suitable for human consumption. The biggest reasons for rejection are identical to the previous researches. The respondents think consuming insects are not fit into their cultural beliefs and they identify insects with the cause of harm. Verbeke (2015) and Tan et al., (2016) discusses the same problem, which they identify as the „yuck factor“. We may say, it is a general problem, not a country-specific one. Nowadays, the price of the insect-based products is not affordable for many people. For instance, 1kg flour from insects costs around 70-75€ which is nearly 50 times more than the price of 1kg bread flour. The respondents named the low retail price as an advantage when it comes to insect-based products, but at the present, it is a misbelief. 45% percent of the respondents would try out an innovative food product, especially the men, who have significantly higher possibility for this outcome.

In conclusion, we would like to make a few recommendations based on our research and secondary data. Consuming insects may be a solution for food security in the future, however until the conventional food products price do not raise significantly compare to the average salaries, it will not be an alternative. In the meantime, the goal should be to introduce these innovative food sources like insects to the consumers. The positive changes in the EU and Switzerland's regulation can be an empowering factor in Europe. It opens opportunities to companies (start-ups possible) and research centers to develop products which are able to decrease the high product prices and destroy the cultural walls.

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