

A Survey of Public Opinion about Entomophagy in Erciyes University

Ebubekir Yüksel* Ramazan Canhilal

Department of Plant Protection, Faculty of Setrani Agriculture, Erciyes University, Kayseri, Turkey

Received: 04.07.2018

Accepted: 25.10.2018

Keywords:

Edible insects, entomophagy, neophobia

Abstract. Edible insects have a good potential to solve the world's food shortage in the future, and might help reduce global hunger and malnutrition. Although entomophagy is very common in some part of the world it is still not well accepted in western countries. In order to determine the attitudes of the young generation in Erciyes University towards entomophagy and the reasons for rejecting entomophagy, a questionnaire survey on 610 participants was conducted in Erciyes University campus in 2017. Of the 610 participants randomly selected in the Erciyes University Campus area, 59.3% were females, and 40.7% were males. With regards to social factors, entomophagy was found to be influenced only by the gender. Although there is a slight neophobia detected (7%), willingness to try edible insects was found low (20%). The most given reason for rejection of entomophagy by participants was disgust factor (47%). The result shows that young generation in Turkey is not ready to consume insects as food. Presumably, this attitude will change in time with the increasing awareness about the benefits of edible insects.

*Corresponding author

ebubekiryuksel@erciyes.edu.tr

Erciyes Üniversitesinde Entomofaji Hakkında Bir Kamuoyu Araştırması

Anahtar kelimeler:

Yenilebilir böcekler, entomofaji, neofobi

Özet. Yenilebilir böcekler, gelecekte dünyanın gıda kıtlığını gidermek için iyi bir potansiyele sahiptir ve küresel açlığı ve yetersiz beslenmeyi azaltmaya yardımcı olabilirler. Entomofaji dünyanın bazı kesiminde oldukça yaygın olmasına rağmen batı ülkelerinde hala kabul görmemiştir. Türkiye'deki genç neslin entomofajiye karşı tutumlarını ve entomofajiyi reddetme nedenlerini belirlemek için, 2017 yılında Erciyes Üniversitesi kampüsünde 610 katılımcı üzerinde bir anket çalışması yapılmıştır. Erciyes Üniversitesi Kampüsünde tesadüfen seçilen 610 katılımcının %59,3'ü bayan, %40,7'si erkek bireylerden oluştuğu belirlenmiştir. Sosyal faktörler bakımından, Entomofaji üzerinde yalnızca cinsiyetin bir etkisi olduğu tespit edilmiştir. Az oranda bir neofobi tespit edilmiş olsa da (%7), yenilebilir böcekleri denemek için istekliliğin düşük (%20) olduğu bulunmuştur. Katılımcıların entomofajiyi reddetmelerinin en yaygın nedeninin iğrenme faktörü olduğu bulunmuştur (%47). Sonuçlar, Türkiye'deki genç neslin böcekleri besin olarak tüketmeye hazır olmadığını göstermektedir. Muhtemelen bu tutum, yenilebilir böceklerin faydaları hakkında giderek artan farkındalık ile zamanla değişecektir.

INTRODUCTION

The need for safe food with the growing world population is constantly increasing. In 2016, the number of chronically undernourished people in the world is estimated to have increased to 815 million although the food production has increased considerably in the past 50 years (Nisbett *et al.*, 2010; Luan *et al.*, 2013; FAO 2017). Studies show that nearly 50 thousand people in Turkey are officially hungry and 1 million 250 thousand people live under the hunger limits (TUIK 2016). Both Turkey's population and the global population will continue to grow with a increasing requirement for food. Recent studies suggest that the world will need 70 to 100% more food by 2050 (Baulcomb *et al.*, 2009). In order to meet the challenges of food deficit in the world, it is both necessary to increase productivity and diversify food production.

Recently, human consumption of edible insects (Entomophagy) has attracted a lot of attention and gaining popularity and acceptance in the world as a promising way to deal with some of the major food and nutrition challenges facing the world (Yen 2009; Yi *et al.*, 2010; Durst *et al.*, 2010; Mitsuhashi 2010; Ash *et al.*, 2010; Vogel 2010; Gahukar 2011; Crabbe 2012; Vanhonacker *et al.*, 2013; Van Huis *et al.*, 2013; Sabado and Aguanta 2015; Narzari and Sarmah 2015; Megido *et al.*, 2016; Akullo *et al.*, 2017). Edible insects are traditionally consumed in many parts of the world (DeFoliart 1997; Ramos-Elorduy 2009) and considered as an important source of food (Belluco *et al.*, 2013; Mlcek *et al.*, 2014; Shockley and Dossey 2014). Up to now, about 2000 species have been used as food and most of them continue to being consumed globally by 2 billion people around the world on a regular basis because of their taste in addition to being nutritious (Nonaka 2009; Jongema 2013; Van Huis *et al.*, 2013; Ghosh *et al.*, 2017).

Insects have numerous features that make them attractive sources of highly nutritious and sustainable food. Studies revealed that edible insects contain high-quality proteins, vitamins and amino acids that are essential for humans (Rumpold and Schluter 2013). Insects also have positive effects on the environment. Insects convert food into protein much more efficiently than livestock do. As most insects require less feed, water, and land to produce than conventional livestock, they enable a cost-effective production (Nakagaki and DeFoliart 1991; Nisbett *et al.*, 2010) and their production generates substantially lower environmental pollutants such as carbon dioxide

(CO₂), ammonia (NH₃) and methane (CH₄). Some insect species such as the black soldier fly, *Hermetia illucens* (L.) and the house fly, *Musca domestica* (L.) can be raised on organic waste and lead to fewer greenhouse gas emissions than the production of livestock animals which is contributing to 18% of the world's greenhouse gas emissions (Steinfeld *et al.*, 2006).

Although there is a reluctance to consume insects as food in some part of the world, there is an increasing interest in edible insects recently and they are now regarded as a class of mini-livestock (DeFoliart 1995; Hardouin 1995; Paoletti 2005; Morris 2008; Van Huis *et al.*, 2013; Kenis *et al.*, 2014; Kelemu *et al.*, 2015). Many researchers around the world are looking for ways to include them in their daily diet and are investigating public attitude towards edible insects (Ebenebe and Okpoko 2015; House 2016; Niassy and Ekesi 2016; Anankware *et al.*, 2017; Akullo *et al.*, 2017). The objective of this study is to determine the attitudes of the young generation in Erciyes University towards entomophagy and the reasons for rejecting entomophagy. This is the first study performed to assess the public attitude towards entomophagy and provide insight into the factors that influence Turkish people's rejection of entomophagy.

MATERIAL AND METHOD

The survey took place in Erciyes University (N=57000) in Kayseri from September to October in 2017 by performing a questionnaire including four closed-ended questions and one open ended question. University students were chosen because they are the target groups for entomophagy in the future (Stöger 2017). Convenience sampling method was used to select participants. A total of 610 students participated in the experiment. No information about entomophagy was given to participants during this questionnaire and demographic characteristics such as age, gender and education level were recorded for each participant.

First, in order to gauge how food neophobic each participant was, participants were asked to rate themselves on how eager they consider themselves when trying new foods in general with responses of very eager, somewhat eager, and reluctant. In the second part, participants were asked to answer "yes" or "no" to the question "Did you know that insects can be consumed as human food?" to determine their awareness about entomophagy. In the next part, participants were asked to give an example of one

insect species that is known to be used by people as human food in the World in an open ended question to ascertain how much they were informed about entomophagy. Participants were then asked to respond "yes" or "no" to the question "Would you really think of consuming insects as food". Lastly, there was another question for participants who chose "no" option in the previous question. They were asked what reason they have for rejection of eating insects with a multiple choice question including options; for religious reasons, being unhealthy, being disgusting and not being nutritious enough.

The data collected were encoded and put in Microsoft Excel and checked before analysis. Data were analyzed with SPSS 9.0. The main method of analysis was cross tabulation between variables in SPSS, obtaining a Chi-square value for gender, age and education level and respective p-value to determine the statistical significance of the relationships between variables according to 5% significance level.

RESULTS AND DISCUSSION

A total of 610 students completed the survey and most participants in the survey were females (59.3%). The ages of the majority of the participants were between 18 and 23 years (Table 1). The educational level of the participants ranged from the associate degree to Master's degrees. The greatest number (82%) having attained in the survey was undergraduate students (Table 1).

Table 1. Demographic characteristics of participants.

Çizelge 1. Katılımcıların demografik özellikleri.

Variations	f	(%)
Gender (N=610)		
Male	248	40.7
Female	362	59.3
Age (N=610)		
18	117	19.2
19	144	23.6
20	139	22.8
21	79	13.0
22	50	8.2
23	47	7.7
24	14	2.3
25	10	1.6
26	10	1.7
Education level (N=610)		
Associate degree	95	15.6
Undergraduate	500	82.0
Master's degree	15	2.5

The relationship between gender ($\chi^2=1.053$, $P=0.591$), and food neophobia was not statistically

significant, nor was the relationship between gender and participants awareness about entomophagy ($\chi^2=0.836$, $P=0.361$). Most of the participants were very eager (51%) to try new foods, only 7% of participants were reluctant. Female participants (56%) were surprisingly more willing to try new foods than male participants (37%) and also more informed about entomophagy (78%) than male participants (75%). In general, participants were well aware of entomophagy with the ratio of 76%. The most well known edible insect species by the participants was locusts which are among the most consumed edible insects species around the world (DeFoliart 1992; Bukkens 1997).

When asked if they would consider eating insects as food, the relationship between gender and willingness to eat insects was statistically significant ($\chi^2 = 49.581$, $P = 0.01$) while the relationship between education level and willingness to eat insects was not important ($\chi^2=0.960$, $P=0.619$). Male participants (31%) showed much more interest than female participants (13%) but general willingness to consume insects as food was very low with the ratio of 20%. The highest positive answer to this question was given by master's degree students with the ratio of 25% followed by associate degree students 23% and undergraduate students 20%.

No significant difference was observed between ages and this question ($\chi^2=16.504$, $P=0.123$). The highest positive ratios were obtained by 23 (32%) and 25 aged participants (29%) and the positive ratios were inconsistent among other ages as they were very close to each others.

Participants with a negative attitude towards entomophagy were asked for their reason behind the rejection; nearly half of the participants (47%) refused eating insects as food due to being disgusting. The other reasons stated were negative taste expectation (19%), religious reasons (16%), unhealthy (12%), and not being nutritious enough (6%) (Figure 1). The relationship between gender and disgust factor was statistically significant ($\chi^2=45.122$, $P=0.001$). Most of the participants refusing entomophagy for the reason of disgusting were females with the ratio of 71%.

DISCUSSION

The present study investigated Erciyes University students attitudes towards entomophagy. The outcomes of the study showed that nearly all participants were willing to try new foods which is important to facilitate the acceptance of entomophagy in Turkey as food neophobia is a crucial factor affecting people's willingness to eat insects (Pliner and Hobden 1992; Hoek *et al.*, 2011; Hartmann

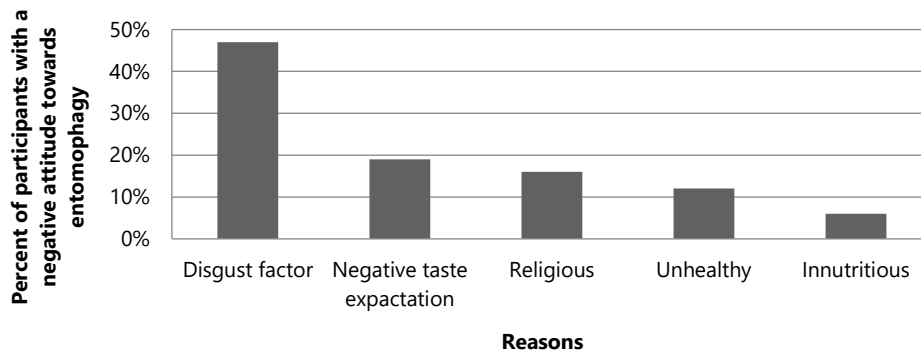


Figure 1. Reasons of participants for rejection of entomophagy.

Şekil 1. Katılımcıların entomofajiyi reddetme nedenleri.

et al., 2015; Verbeke 2015). Awareness of entomophagy among participants (76%) was very high which is higher than the study carried out in Belgium (61%) and lower than the study in Korea (88%) (Megido *et al.*, 2014; Gosh *et al.*, 2017). This high awareness of entomophagy can be a sign for future acceptance of entomophagy because studies showed that there is a positive correlation between awareness of people about the benefits of eating insects and acceptance of entomophagy (Verneau *et al.*, 2016; Stöger 2017).

Results revealed that participants had a low willingness to eat insects (20%) compared to another European country Belgium (77%) (Megido *et al.*, 2014). Similarly a low level of willingness was also observed in Germany (33%), in Italy (31%) and in Australia (25%) (Hartmann *et al.*, 2015; Cicatiello *et al.*, 2016; Stöger 2017). One of the biggest factor affecting people's willingness to eat insects is feelings of disgust as indicated in the previous study in the USA, 57% of the people surveyed rejected insects as food, due to the feeling of disgust (Ruby *et al.*, 2015). Culture has a strong influence on the feeling of disgust and perception of edible insects (Mela 1999; Mignon 2002). In some cultures, insects are associated with fear and are perceived as disgusting among the general public (Kellert 1993; Haidt *et al.*, 1994; Ramos-Elorduy 2009). However, this cultural perception can change in time and become popular as in the case of quinoa, kombucha, acai juice, and goji berries (Shelomi 2015). Several insects are often in contact with spoiled or decaying items and these images in people's memories would evoke disgust reaction and negative taste expectation (Rozin and Fallon 1987). In Islamic tradition, it is known to be eaten insects such

as locusts, bees, and ants (El-Mallakh and El-Mallakh 1994). Raising awareness of people about the origin, nutritional values and safety of edible insects can help take a positive attitude towards entomophagy (Nonaka 2005).

Several studies found no difference between gender and neophobia which are in line with our findings (Pliner and Hobden 1992; Johns *et al.*, 2011). Gender and willingness were found to have significant effects. Results showed that men participants (31%) are more willing to eat insects as food than women participants (13%) in our survey as in other studies. Verbeke *et al.* (2015), found that males are 2.17 times more likely than females to adopt insects which is close to our studies (2.38). The other studies also show that males are more positive towards entomophagy (Ruby *et al.*, 2015; Gosh *et al.*, 2017). The possible reasons for this low willingness in female participants may be due to the fact that they are more disgusted and more fearful of insects (Kellert 1993; Schösler *et al.*, 2012).

Although entomophagy is not common in the tradition of Turkish society to date, the results of this study seem promising for the future. The low level of neophobia found in this study shows that young generation is willing to try new things as food and they will adopt a much more positive attitude towards entomophagy with awareness-raising studies about the benefits of edible insects in the near future in Turkey.

ACKNOWLEDGEMENTS

This study was supported by TUBITAK BİDEB-2209 student project. The author would like to thank

Ramazan Kara, Elif Dertli, Asım Gümüşsoy and Ebru Cetin of Erciyes University, Faculty of Agriculture, Department of Plant Protection for helping data collection.

REFERENCES

- Akullo J., Obaa BB., Acai JO., Nakimbugwe D and Agea JG., 2017. Knowledge, attitudes and practices on edible insects in Lango sub-region, northern Uganda. *Journal of Insects as Food and Feed*, 3(2): 73-81.
- Anankware PJ., Osekre EA., Obeng-Ofori D and Khamala CM., 2017. Factors that affect entomophagical practices in Ghana. *Journal of Insects as Food and Feed*, 3(1): 33-41.
- Ash C., Jasny BR., Malakoff DA and Sugden AM., 2010. Feeding the future. *Science*, 327(5967): 797-797.
- Belluco S., Losasso C., Maggioletti M., Alonzi CC., Paoletti MG and Ricci A., 2013. Edible insects in a food safety and nutritional perspective: a critical review. *Comprehensive Reviews in Food Science and Food Safety*, 12(3): 296-313.
- Bukkens SGF., 1997. The nutritional value of edible insects. *Ecology of Food and Nutrition*, 36(2-4): 287-319.
- Cicatiello C., De Rosa B., Franco S and Lacetera N., 2016. Consumer approach to insects as food: barriers and potential for consumption in Italy. *British Food Journal*, 118(9): 2271-2286.
- Crabbe N., 2012. Local expert gets funding to develop insect-based food for starving children. <http://www.gainesville.com/news/20120509/local-expert-gets-funding-to-develop-food-based-on-insects>. [Access: January 20, 2018].
- DeFoliart GR., 1992. Insects as human food: Gene DeFoliart discusses some nutritional and economic aspects. *Crop protection*, 11(5): 395-399.
- DeFoliart GR., 1995. Edible insects as minilivestock. *Biodiversity and Conservation*, 4: 306-321.
- DeFoliart GR., 1997. An overview of the role of edible insects in preserving biodiversity. *Ecology of Food and Nutrition*, 36(2-4): 109-132.
- Durst PB., Johnson DV., Leslie RN and Shono K., 2010. *Forest Insects As Food: Humans Bite Back*. Food and Agriculture Organization of the United Nations, Chiang Mai, Thailand.
- Ebenebe CI and Okpoko VO., 2015. Edible insect consumption in the southeastern Nigeria. *International Journal of Science and Engineering*, 6(6): 171-177.
- El-Mallakh OS and El-Mallakh RS., 1994. Insects of the Qur'an (Koran). *American Entomologist*, 40: 82-84.
- FAO 2017. *The State of Food Insecurity in the World*. FAO, Rome.
- Gahukar RT., 2011. Entomophagy and human food security. *International Journal of Tropical Insect Science*, 31(3): 129-144.
- Ghosh S., Lee SM and Jung C., 2017. Perception of entomophagy in Korean population. *Korean Society of Applied Entomology Fall Conference and International Symposium*, 12-14 October, Seoul.
- Haidt J., McCauley C and Rozin P., 1994. Individual differences in sensitivity to disgust: A scale sampling seven domains of disgust elicitors. *Personality and Individual Differences*, 16(5): 701-713.
- Hardouin J., 1995. Minilivestock: from gathering to controlled production. *Biodiversity Conservation*, 4: 220-232.
- Hartmann C., Shi J and Giusto A., 2015. The psychology of eating insects: a cross-cultural comparison between Germany and China. *Food Quality and Preference*, 44: 148-156.
- Hoek AC., Luning PA., Weijzen P., Engels W., Kok FJ and de Graaf C., 2011. Replacement of meat by meat substitutes. A survey on person- and product-related factors in consumer acceptance. *Appetite*, 56: 662-673.
- House J., 2016. Consumer acceptance of insect-based foods in the Netherlands: academic and commercial implications. *Appetite*, 107: 47-58.
- Johns N., Edwards JS and Hartwell H., 2011. Food neophobia and the adoption of new food products. *Nutrition and Food Science*, 41(3): 201-209.
- Jongema Y., 2013. List of edible insects of the world. <http://www.wageningenur.nl/en/Expertise-Services/Chair-groups/Plant-Sciences/Laboratory-of-Entomology/Edible-insects/Worldwide-species-list.htm>. [Access: January 20, 2018].
- Kelemu S., Niassy S., Torto B., Fiaboe K., Affognon H and Tonnang H., 2015. African edible insects for food and feed: inventory, diversity, commonalities and contribution to food security. *Journal of Insects as Food and Feed*, 1(2): 103-119.
- Kellert SR., 1993. Values and perceptions of invertebrates. *Conservation Biology*, 7(4): 845-855.
- Kenis M., Kone N., Chrysostome CAAM., Devic E., Koko GKD and Clotey VA., 2014. Insects used for animal feed in West Africa. *Entomologia*, 2: 104-114.
- Luan Y., Cui X and Ferrat M., 2013. Historical trends of food self-sufficiency in Africa. *Food Security*, 5: 393-405.
- Megido RC., Sablon L., Geuens M., Brostaux Y., Alabi T., Blecker C and Francis F., 2014. Edible insects acceptance by Belgian consumers: promising attitude for entomophagy development. *Journal of Sensory Studies*, 29(1): 14-20.
- Megido RC., Gierts C., Blecker C., Brostaux Y., Haubruge É., Alabi T and Francis F., 2016. Consumer acceptance of insect-based alternative meat products in Western countries. *Food Quality and Preference*, 52: 237-243.

- Mela DJ., 1999. Food choice and intake: the human factor. *Proceedings of the Nutrition Society*, 58: 513-521.
- Mignon J., 2002. L'entomophagie: une question de culture? *Tropicicultura*, 20(3): 151-155.
- Mitsuhashi J., 2010. The Future Use of Insects as Human Food, 115. *Proceedings of a workshop on Asia-Pacific resources and their potential for development*, 19-21 February, Chiang Mai, Thailand.
- Mlcek J., Rop O., Borkovcova M and Bednarova M., 2014. A comprehensive look at the possibilities of edible insects as food in Europe – a review. *Polish Journal of Food and Nutrition Sciences*, 64(3): 147-157.
- Morris B., 2008. Insects as food among hunter-gatherers. *Anthropology Today*, 24: 6-8.
- Nakagaki BJ and DeFoliart GR., 1991. Comparison of diets for mass-rearing acheta dornesticzs (Orthoptera: Gryllidae) as of food conversion efficiency with values reported for livestock. *Journal of Economic Entomology*, 84(3): 891-896.
- Narzari S and Sarmah J., 2015. A study on the prevalence of entomophagy among the Bodos of Assam. *Journal of Entomology and Zoological Studies*, 3(2): 315-320.
- Niassy S and Ekesi S., 2016. Contribution to the knowledge of entomophagy in Africa. *Journal of Insects as Food and Feed*, 2(3): 137-138.
- Nisbett J., Pretty J., Robinson S., Toulmin C and Whiteley R., 2010. The future of the global food system. *Philosophical Transactions of the Royal Society of London*, 365: 2769-2777.
- Nonaka K., 2005. *Ethnoentomology: Insect Eating and Human-Insect Relationship*. University of Tokyo Press, Tokyo.
- Nonaka K., 2009. Feasting on insects. *Entomological Research*, 39(5): 304-312.
- Paoletti MG., 2005. *Ecological Implications of Minilivestock: Potential of Insects, Rodents, Frogs and Sails*. CRC Press.
- Pliner P and Hobden K., 1992. Development of a scale to measure the trait of food neophobia in humans. *Appetite*, 19: 105-120.
- Ramos-Elorduy J., 2009. Anthro-entomophagy: cultures, evolution and sustainability. *Entomological Research*, 39: 271-288.
- Rozin P and Fallon AE., 1987. A perspective on disgust. *Psychological Review*, 94(1): 23-41.
- Ruby MB., Rozin P and Chan C., 2015. Determinants of willingness to eat insects in the USA and India. *Journal of Insects as Food and Feed*, 1(3): 215-225.
- Rumpold BA and Schlüter OK., 2013. Nutritional composition and safety aspects of edible insects. *Molecular Nutrition and Food Research*, 57(5): 802-823.
- Sabado EM and Aguanta LM., 2015. *Consumer Awareness and Acceptance of Edible Insects in Marawi City, Philippines: Potentials for Food Security*. BANWA Supplements, 1A.
- Shelomi M., 2015. Why we still don't eat insects: Assessing entomophagy promotion through a diffusion of innovations framework. *Trends in Food Science and Technology*, 45(2): 311-318.
- Shockley M and Dossey AT., 2014. *Insects For Human Consumption Mass Production of Beneficial Organisms: invertebrates and entomopathogens* (Eds. Morales-Ramos JA., Guadalupe Rojas M and Shapiro-Ilaned D), Academic Press.
- Schösler H., de Boer J and Boersema JJ., 2012. Can we cut out the meat of the dish? Constructing consumer-oriented pathways towards meat substitution. *Appetite*, 58(1): 39-47.
- Steinfeld H., Gerber P., Wassenaar TD., Castel V and de Haan C., 2006. *Livestock's Long Shadow: Environmental Issues and Options*. Food and Agriculture Organization of the United Nations, Rome.
- Stöger L., 2017. Entomophagy in Vienna—a vision for our future? http://www.schulentwicklung.at/joomla/images/stories/oekolog/Entomophagy_in_Vienna_a_Vision_for_Our_Future_Leo_Stoeger_2017.pdf. [Access: January 20, 2018].
- TUIK, 2016. Poverty statistics based on income. http://www.tuik.gov.tr/PreTablo.do?alt_id=1013 [Access: January 20, 2018].