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Edible insect consumption and Turkish consumers' attitudes towards entomophagy

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Abstract

Generally, in the world edible insects have gained popularity and awareness among people. Therefore, the study on Turkish consumers' attitudes and consumption towards entomophagy has important findings. The relationships edible insects with sociodemographic effects, demand to eat and personality traits of participants were determined by online questionnaire method. According to the results, most of the participants have not consumed edible insects before and furthermore both male and female consumers were not found to be positive tendency for eating edible insects. The main factors of rejection behaviors are disgusting, food neophobia and some health and religious concerns. However, a few participants have already consumed edible insects and have mainly exhibited this experience in abroad. Thereby, the study suggests that familiarity and awareness are the most significant factors changing attitudes towards to edible insect consumption for Turkish consumers. To determine consumption behavior and preferences of Turkish consumers, the most significant factors are overpassing the psychological barrier such as neophobia and facilitate entomophagy acceptance. This study could enable the development of strategies to increase desire of eating EI (edible insects) by Turkish consumers and promote insect production.

Keywords

Entomophagy, Edible insects, Consumers' attitudes, Neophobia

Introduction

The detrimental effects of global warming, climate change and industrial pollution cause different stress factors that affect plant survival and growth, soil properties and diversity of microbial communities (Peters, 1990). On the other hand, the global food shortage wave is likely to hit the world (Botkin et al., 2007), due to the population continues to increase in Turkey as in the world and the decrease in arable agricultural land and forests with urbanization. Therefore, alternative solutions to food sources should be developed urgently. Edible insects (EI) have great potential as an alternative, environmental friendly food source of future. Edible insects offer a sustainable solution to several problems that threaten the environment and human health, including climate

change, ecological crisis and troubles from agro-industrial production.

The use of edible insects as an unconventional food source is increasing day by day for sustainability. Another reason of increasing is lack of nutritional sources such as protein, which is insufficient in some regions where food resources are becoming increasingly decrease (Flachowsky et al., 2017). In addition, edible insects, which are a new product for people's seeking for new taste and flavor, contain many nutrients such as protein, fatty acids, vitamins, and minerals which necessary for a healthy life (Rumpold and Schlüter, 2013). In addition, edible insects require less water and space requirements and cause lower greenhouse gas emissions during production. Realizing the production of edible insects with more sustainable characteristics towards the environment, they are more effective at

changing digested matter to biomass compared to conventional livestock.

Most insect species which used in insect production have high amount of protein, fatty acids, fiber, vitamins and minerals (Belluco et al., 2013; Finke and Oonincx, 2014). The chemical composition of insects differs depending on the species and genus, diet, period of growth (Ramos-Elorduy, 2002; Oonincx and Van Der Poel, 2011) and the habitat in which natural environment of the insects live. In addition, the nutritional composition of insects is probable to be affected by the preparation methods such as frying, boiling, baking, grinding and drying for consumption. Although the preparation methods and insect characteristics are different, insects are an unconventional source of quality animal protein (Verkerk et al., 2007; Srivastava et al., 2009). Although the edible insect consume risks in terms of food safety and health are not clear, edible insects are consumed as a nourishing and pleasant-tasting food source in a great number of societies of the world due to differences in nutritional value (Verkerk et al., 2007; Srivastava et al., 2009; Klunder et al., 2012; Imathiu, 2020).

Entomophagy is a term that consuming insects as food and it includes about 1500-2000 known species, in Asia, Africa, Australia and United States of America. The most common types of EI are Coleoptera (31%), Lepidoptera (18%), Hymenoptera (14%), Orthoptera (13%), Hemiptera (10%), Isoptera (3%), Odonata (3%), Diptera (2%) and others (5%) (Van Huis et al., 2013). In European countries, although consumer acceptance is low, its awareness and preference is becoming more common.

According to studies, the main reason of low preference to consume in European countries is food neophobia which is related to human behaviors such as sources of disgust (consumption of insects, abnormal fear, bad odors) (Gere et al., 2017; Piha et al., 2018; Mancini et al., 2019; Lammers et al., 2019; Orkusz et al., 2020; Florença et al., 2021; Detilleux et al., 2021). The neophobic consumers have a tendency to avoid and reluctant to try new foods as similar to children's reluctance to eat novel food. However this behavior might be change, for example, edible insects can be integrated in different dishes such as meat products, sauces, bakery products, cookies and protein bars (Homann et al., 2017; Piha et al., 2018; Orkusz et al., 2020; Detilleux et al., 2021).

Considering the articles have been published on the opinions of Turkish consumers regarding edible insect, in literature there is a few numbers of research on the term of entomophagy in the Turkey (Karaman and Bozok, 2019; Kaymaz and Ulema, 2020). The goal of the current study is to investigate knowledge and attitude of the respondents in Turkey about potential of insects and insect-based products or dishes.

Within this framework, we get to know about the impact of gender and sociodemographic factors on attitudes towards edible insects as a food product, to identify the factors that prevent the consumption of edible insects and the reasons for motivation to consume of edible insects. Moreover, it is planned the outcomes of this study contribute to the existing literature on edible insect consumption.

Materials and Methods

Data collection and sampling

In this study, an online questionnaire was used to analyze for determination of Turkish consumers' attitudes for edible insect consumption. The data collection was widely disseminated nationwide in October 2021 via email, social media platforms and personal references. Respondents willingly filled out the questionnaire and were not given any incentives.

Questionnaire design

The survey consisted of 18 questions and questionnaire design was divided into the four parts, regarding about demographics, general knowledge about entomophagy, desire to consume and consumption experience (Hartmann et al., 2015; Barsics et al., 2017). Sociodemographic questions consisted of question on gender, age, residence, education level, occupation and income.

For general knowledge about entomophagy, participants answered the following the questions; "Have you ever previously heard of the term entomophagy? if you heard, where had you learned about entomophagy?", 'Do you aware of any benefits of EI?' and 'Have you eaten EI before?'. In third part of questionnaire, questions about the desire to consume were asked to participants such as their opinion on the desire, factors that prevent the consumption of EI and demand for different forms of edible insects. Finally in the last part, participants, who had tasted, responded questions concerning; the consumption place(s) of edible insects, entomophagy experience, the form of consumed insects and consumption frequency.

Statistical analysis

The results of questionnaire about edible insect consumption and determination of Turkish consumers' attitudes were performed by using statistical software SPSS V22 (SPSS Inc., Chicago, IL, USA). Basic descriptive statistics was used to summarize findings by describing the relationship between variables in the study. In addition, a crosstab tool combined with the chi-square test was used to evaluate whether there were significant relationships between some of the categorical variables examined considering the 5% significance level. Determining to the effects on edible insect consumption, a P-value of < 0.05 was considered statistically significant.

Results and Discussion

Demographic features

A total of 427 fully filled questionnaires, thought to represent the population in Turkey, were collected. Concerning sociodemographic variables of participants, the sample consisted of 52.9% men and 47.1% women, which relates to the sex distribution in Turkey (50.1% male; 49.9% female). The all respondents were living in Turkey and over the age of fifteen. Age of the respondents ranged from 18 to 88, and more than half of the participants were under age 35 (51.1%). Respondents were from 39 cities placed every region in Turkey and the most was from İstanbul (65.2%). Majority of the respondents had a high education level (Bachelor's degree and higher 56.4%) and working in different areas (Table 1). The annual income of is classified by proportioning the annual net amount of the

2021 minimum wage in Turkey (Ministry of Labor and Social Security).

Table 1. Sociodemographic features of the participants

Sociodemographic features	n	Percent (%)
Gender		
Male	226	52.9
Female	201	47.1
Age		
18–25 years	116	27.2
26–35 years	102	23.9
35< years	209	48.9
Education level		
High school or below	48	11.2
University student	92	21.5
Associate degree	46	10.8
Bachelor's degree and higher	241	56.4
Annual Income		
Under 34.000TL	131	30.7
34.000TL-47.999TL	53	12.4
48.000TL-71.999TL	96	22.5
72.000TL-120.000TL	90	21.1
Over 120.000TL	57	13.3
Occupation		
Student	192	45.0
Food staff	44	10.3
Others	191	44.7

General knowledge about entomophagy

After the demographic questions, knowledge levels and attitudes of participants about entomophagy were measured (Table 2). According to results, most of the participants (62.3%) had not heard of the term entomophagy and 40.5% of participants gained

familiarity of entomophagy via this study. Although 58.1% of the participants are not aware of the benefits of insect consumption (Table 2), participants who have knowledge about the insect consumption, consider insects as a cheap and nutritious food source (Figure 1).

Table 2. General knowledge about entomophagy of the participants

Variables	n	Percent (%)
Hearing of entomophagy		
Yes	161	37.7
No	266	62.3
Where was learned		
Family/Friends	25	5.9
School	27	6.3
Restaurant	4	0.9
TV/Books/News	95	22.2
Internet/Social media	79	18.5
Travel abroad	24	5.6
In this study	173	40.5
Behavior		
Beneficial	175	41
Ineffective	4	0.9
No idea	248	58.1

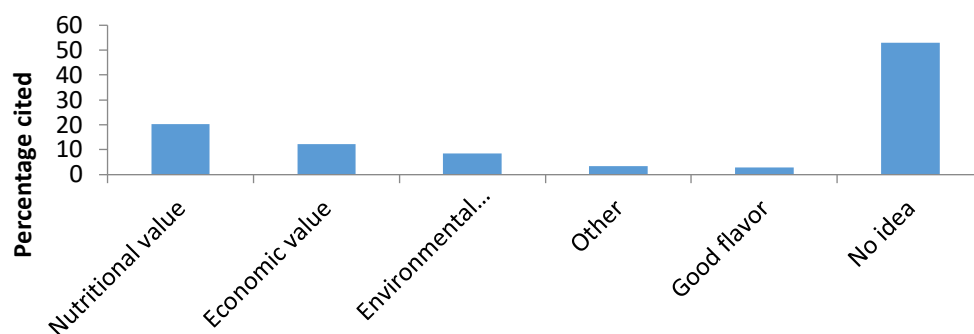


Figure 1. Considered benefits of edible insect production and consumption by participants

About 94.1% of participants (n=402) had not consumed edible insects (Table 3) and of these, 79.6% have significantly unwilling to consume ($p<0.05$). The relationship between sociodemographic variables (gender, age, education level, annual income, and occupation) and willing to consume edible insects was not statistically significant (respectively $\chi^2 = 1.725$. P

$=0.631$; $\chi^2 = 22.953$. $P=0.001$; $\chi^2 = 24.615$. $P=0.003$; $\chi^2 = 20.139$. $P=0.065$). Although, the most of participants (78.6%) do not want to try and to consume edible insects whatever form it has, a little part of participants (14.1%), who have willing to try the edible insects, want to consume in invisible form ($p<0.05$).

Table 3. Willing to edible insects of the participants

Variables	n	Percent (%)
Consuming edible insects		
Yes	25	5.9
No	402	94.1
Willing to consume (n:402)		
Unwilling	340	79.6 ^a
Willing	53	12.4 ^b
Undecided	9	2.1
Desired consumption form (n:402)		
Visible	29 ^a	7.2 ^a
Invisible	57 ^b	14.1 ^b
Unwilling	316	78.6

Different letters in the table means with differ significantly ($p<0.05$).

According to respondents, the major factors influencing consumption of edible insects were determined as being disgusting (Figure 2). Therefore, more than half of the respondents refused eating EI as food (54.7%). Consistently, health and religious concerns (29.2%) and unfamiliar (8.1%) were the other reasons for refusal of EI consumption in their diets. Bad flavor (3.6%), negative environmental impact (1.9%),

low availability (1.3%) and social/cultural pressure (1.2%) were stated as another reason. Despite a growing awareness of nutritional and environmental benefits, desires of EI consumption do not increase similarly for majority of the population. This phenomenon has been explained as a consequence of the psychological barriers of consumers.

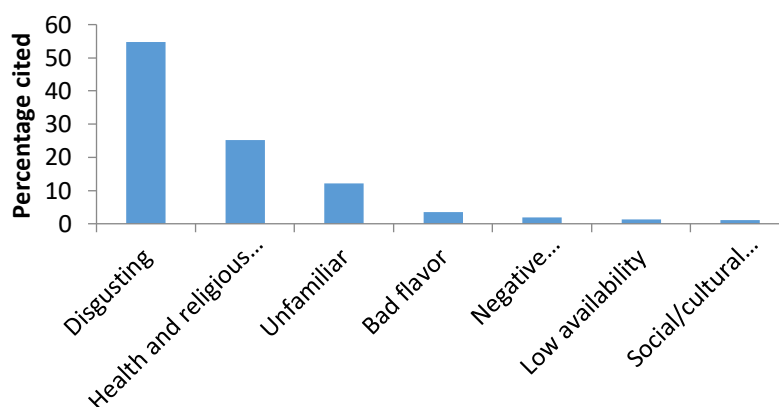


Figure 2. Factors influencing consumption of edible insects

According to the findings, only 5.9% of respondents (n=25) had eaten edible insects before this study (Table 3). Most of the Turkish experienced respondents (76%)

have tried edible insects once, during traveling abroad (84.0%) ($p<0.05$) and have approximately 80.0% satisfied with this experience. Moreover, more than half

of the experienced participants (52%) expressed their appearance as neutral. Overall, Turkish consumers showed a neutral attitude towards eating again, buying and consuming regularly edible insects. Therefore, the production and sale of edible insects remains limited in Turkey. Form of edible insects was found as a factor

affecting consumption frequency and willing for consumption. The form of edible insects influences consumers' willing. About 40.0% of respondents, who consumed before, consumed visible type of insects and 60.0% of respondents who consumed before, consumed foods containing invisible insect ingredients.

Table 4. Consumption experience of the participants at study (n=25)

Variables	N	Percent (%)
Entomophagy experience		
Bad	5	20.0 ^b
Neutral	13	52.0 ^a
Good	7	28.0 ^b
Consumption place		
Travel abroad	21	84.0 ^a
Local restaurant	4	16.0 ^b
Form of consumed insects		
Visible	10	40.0
Invisible	15	60.0
Consumption frequency		
Tried it once	19	76.0
Tried it more than 2 times	5	20.0
Occasionally/regularly	1	4.0

Different letters in the table means with differ significantly ($p < 0.05$).

Evaluating the awareness of Turkish consumers is crucial to understand their preference of EI consumption. The attitude for EI consumption is desired to be consumed more by men compared to women in America (Woolf et al., 2019), but in Turkey, the significant difference in EI consumption was not found between the gender in this study ($p > 0.05$).

Previous researches, in Uganda (Olum et al., 2021), Italy (Palmieri et al., 2019) and Germany (Hartmann et al., 2015; Lammers et al., 2019) show that consumers' education level and familiarity are affected on consumption of edible insects. Moreover, edible insects are frequently consumed in Asia (Mitsuhashi, 1997; Hanboonsong et al., 2013; Yen, 2015; Liu et al., 2019) and Africa (Hlongwane et al., 2020). However, according to results; edible insects are not preferred by Turkish consumers of all ages and segments. These differences could be probably related to wide range of products and dishes in Turkish cuisine arise from varying climate due to geographical location of Turkey.

Researches in the field of edible insect consumption show that the factors of low tendency towards edible insects are food neophobia, insect phobia and disgusting (Liu et al., 2019; Sogari et al., 2019; Toti et al., 2020; Olum et al., 2021). In this study, although the main factors of rejection behaviors are disgusting and food neophobia, religious and health concerns are other factors influencing consumption of edible insects.

The main reason for this attitude stems from the unfamiliarity and lack of knowledge of consumers about edible insects. Moreover, consumers are very little aware of the term of entomophagy, but the major group have become aware of it by this study and have offered thank for the study. Therefore, it can be stated that the study increased awareness on the term of entomophagy. Additionally, the participants who more familiar and informed about entomophagy, they have felt more willing to consume EI ($p < 0.05$).

Another finding that supports a significant contribution to familiarity is that only 5.9% of Turkish participants consume EI in the present study, while 88% of respondents in the Kenyan consumer consume EI (Pambo et al., 2016). The cause of this ratio may be that the awareness and consumption of entomophagy is higher in other countries such as Belgium and Kenya. These results give a lead about increasing the consumption of EI as the societies are informed about the term of entomophagy. In addition, the briefing sessions has been presented to develop willingness to consume EI (Barsics et al., 2017). This study also agrees with the findings of Pambo et al. (2016), who reported that EI consumption is positively affected by increased knowledge of entomophagy.

More than half of the respondents currently do not want to consume EI due to the "disgust" factor. Studies have shown that the disgust response in societies is learned at a young age and is generally passed down through generations (La Barbera et al., 2018; Woolf et al., 2019). In order to prevent this, information on edible insects should be included in primary school education, websites, and nutritional advice (Van Huis., 2016). Furthermore, informing parents will increase their children's familiarity with edible insects and will affect their consumer approach in the future (Looy et al., 2014).

Conclusion

Edible insects are consumed by societies in the world as an integral part of gastronomic culture. For some time, EI has been discussed and surfaced as a sustainable food source, as the world population has continued and will continue to increase at a rate incompatible with the current state of Earth resources. Edible insects have been shown to have great potential at both the nutritional and environmental levels.

The main purpose of this work is to determine Turkish consumers' attitudes towards entomophagy and

remove the barriers production and consumption of edible insects. Therefore, this study is specially considered that how some factors such as demographic, familiarity, knowledge of entomophagy and concerns affect to decision of Turkish consumers to consume edible insects.

In this study has shown the results from a sample of Turkish consumers' regarding knowledge, attitude and degree of acceptability of EI consumption. It was revealed that the majority of the respondents who were participated to survey did not consume edible insects at all, and those who did mostly consumed it abroad.

Based on these findings, for possible introduction of EI into the Turkish food market should start by foods that incorporate EI such as invisible forms can be recommended. Additionally, although people in Turkey seem aware of the implications of consuming EI at the sustainability level, concerning their nutritional and health effects, the Turkish consumers do not want to consume edible insects due to the food neophobia and some health and religious concerns. Therefore, it is still necessary to raise the dissemination of information about the advantages and/or limitations of edible insects.

Compliance with Ethical Standards

Conflict of interest

The authors declared that for this research article, they have no actual, potential, or perceived conflict of interest.

Author contribution

The contribution of the authors to the present study is equal. All the authors read and approved the final manuscript. All the authors verify that the Text, Figures, and Tables are original and that they have not been published before.

Ethical approval

Ethical approval for the study was obtained from Istanbul Rumeli University (Decision No: 9, Protocol No: 2021/08, Date: 13.10.2021).

Not applicable.

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Data availability

Not applicable.

Consent for publication

Not applicable.

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