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THE KNOWLEDGE, PERCEPTION, AND ACCEPTABILITY OF INSECTS AS FOOD AMONG THE EAST COAST MALAYSIANS

Nur Zulaikha Kamaruzaman[1], Tan Yi-Li[1], Nurul Hanisah Juhari[2], Abd Rahim Muhamad Hafiz[3,4] & Mohammad Rashedi Ismail-Fitry[1,4,5]*

[1]Department of Food Technology,
Faculty of Food Science and Technology,
Universiti Putra Malaysia,
43400 UPM Serdang, Selangor, Malaysia
[2]Department of Food Service and Management,
Faculty of Food Science and Technology,
Universiti Putra Malaysia,
43400 UPM Serdang, Selangor, Malaysia
[3]Department of Food Science,
Faculty of Food Science and Technology,
Universiti Putra Malaysia,
43400 UPM Serdang, Malaysia
[4]Future Food, Faculty of Food Science and Technology,
Universiti Putra Malaysia,
43400 UPM Serdang, Malaysia
[5]Halal Products Research Institute,
Universiti Putra Malaysia,
43400 UPM Serdang, Selangor, Malaysia
*Corresponding author; email: *ismailfitry@upm.edu.my*

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ABSTRACT

Insects have gained attention as a sustainable protein source, yet entomophagy remains relatively unpopular, particularly in modern societies like Malaysia. This study evaluates the knowledge, acceptability, and perceptions of insect consumption among residents of the East Coast of Malaysia (ECM). A structured survey was administered to 201 respondents, gathering data on socio-demographic factors, knowledge, perceptions, and acceptability of insects as food. Descriptive statistics, cross-tabulation, correlation, and regression analysis were conducted using IBM SPSS Statistical version 26. A majority of respondents (74.6%) demonstrated moderate knowledge about insect consumption; however, 60.7% of respondents held negative perceptions, and 79.6% showed low acceptability, with significant sociodemographic differences by ethnicity, education, income, gender, and age. A positive relationship was found between knowledge, perceptions, and willingness to consume insect-containing foods (ICF), with statistical data confirming knowledge, acceptability, and perception as significant predictors of ICF willingness ($P<0.05$). The findings highlight the need for public education to improve perceptions and increase consumer acceptance of insects

as a viable protein source. Addressing safety and halal compliance concerns is essential to foster greater acceptance. Future research should expand the sample size and data collection period to explore the commercialisation potential of insects as food in Malaysia.

Keywords: Consumer acceptability; edible insects; entomophagy; future foods; protein alternatives

ABSTRAK

Serangga telah mendapat perhatian sebagai sumber protein yang lestari, namun amalan entomofagi (pemakanan serangga) masih kurang popular, terutamanya dalam masyarakat moden seperti di Malaysia. Kajian ini menilai tahap pengetahuan, penerimaan, dan persepsi mengenai pemakanan serangga dalam kalangan penduduk Pantai Timur Malaysia (ECM). Satu kaji selidik berstruktur telah dijalankan melibatkan 201 peserta, data berkaitan faktor sosio-demografi, pengetahuan, persepsi, dan penerimaan serangga sebagai makanan dikumpulkan. Statistik deskriptif, analisis silang tabulasi, korelasi, dan regresi dilakukan menggunakan IBM SPSS Statistik Versi 26. Keputusan menunjukkan 74.6% daripada responden mempunyai pengetahuan sederhana mengenai pemakanan serangga, 60.7% responden mempunyai persepsi negatif, dan 79.6% menunjukkan tahap penerimaan yang rendah, dengan perbezaan ketara berdasarkan faktor sosio-demografi seperti etnik, pendidikan, pendapatan, jantina, dan umur. Hubungan positif ditemui antara pengetahuan, persepsi, dan kesediaan untuk makan makanan berasaskan serangga (ICF), dengan keputusan statistik mengesahkan pengetahuan, penerimaan, dan persepsi sebagai peramal signifikan kesediaan untuk makan ICF ($P<0.05$). Penemuan ini menekankan keperluan pendidikan awam untuk memperbaiki persepsi dan meningkatkan penerimaan pengguna terhadap serangga sebagai sumber protein yang berdaya maju. Menangani isu keselamatan dan pematuhan halal adalah penting untuk memupuk penerimaan yang lebih luas. Penyelidikan masa depan perlu memperluaskan saiz sampel dan tempoh pengumpulan data untuk meneroka potensi pengkomersialan serangga sebagai makanan di Malaysia.

Kata kunci: Kebolehterimaan pengguna; serangga boleh dimakan; entomofagi; makanan masa depan; alternatif protein

INTRODUCTION

In the coming decades, the global challenge of ensuring local food self-sufficiency is expected to intensify due to a combination of environmental and socio-economic factors. Climate change is projected to impact agricultural productivity, altering weather patterns, reducing crop yields, and increasing the frequency of extreme weather events. These changes, coupled with ongoing land degradation and the scarcity of arable land, pose significant threats to the local production of sufficient food. As the global population continues to grow rapidly, expected to reach nearly 10 billion by 2050, the demand for food will place even greater pressure on the already strained agricultural system (Nadathur et al. 2024).

In response to these challenges, there is growing interest in alternative food sources that offer both sustainability and nutritional value. Among these alternatives, insects have emerged as a more sustainable option (Carrigan et al. 2023). Insects are rich in protein and can efficiently convert raw materials into valuable, protein-rich biomass, making them a promising method for reducing food waste (Fairuz et al. 2023; Fuso et al. 2024). For example, Black Soldier Fly Larvae have been shown to convert agro-waste, such as banana peels, into biomass; however,

their efficiency is greater when reared on conventional feed, such as chicken feed (Gunggot & Lardizabal 2024). Food waste has also been utilised as a rearing medium for mealworms and field crickets, and the resulting insects have been evaluated as protein-rich feed ingredients for ruminants (Husna et al. 2023). In addition, insect farming requires significantly fewer resources, such as land, water, and feed, while producing lower greenhouse gas emissions compared to traditional livestock (Benoit & Mottet 2023). As a result, insects are a viable alternative to various other food sources.

Edible insects have been consumed in over 120 countries, with around 2,000 species regularly eaten (Jongema 2017; Wendin et al. 2019). Commonly consumed insects include beetles, caterpillars, grasshoppers, crickets, and ants, which can be prepared through frying, drying, or processed into flour and protein powder (Anagonou et al. 2023; Mohd Zaini et al. 2023). Insects also generate antimicrobial peptides that fight bacteria, fungi, and cancer cells (Yi et al. 2014; Wu et al. 2018). Their high digestibility is comparable to animal proteins like beef and salmon, with similar muscle protein synthesis effects (Hernández-álvarez et al. 2022; Ma et al. 2023). Studies show that insect protein does not raise glucose levels and lowers insulin post-meal, although findings on inflammatory markers and gut microbiota remain inconclusive (Cunha et al. 2023; Zhao et al. 2019). However, individuals allergic to shellfish or house dust mites may be at risk of allergic reactions (Fuso et al. 2024; de Gier &Verhoeckx 2018).

Recently, various commercial insect-based products, such as energy bars, burgers, and snack foods, have entered the market (Siddiqui et al. 2023; Suganisha et al. 2023). A study by Lammers et al. (2019) found that participants were more willing to try insect-based burgers than buffalo worms, the main ingredients of the burger. This suggests that processed Insect-Containing Food (ICF) may be more readily accepted than unprocessed insects (Lammers et al. 2019). Videbæk & Grunert (2020) discovered that Dutch consumers' curiosity about insects as a food source motivated them to try insects in both visible and hidden forms. Rather than being repelled by disgust, these consumers were driven by their interest, showing that stimulating curiosity could help overcome barriers to entomophagy. Promoting the health and environmental benefits of insect consumption could further boost interest (Nyberg et al. 2020; Ruby & Rozin 2019). In Italy, approximately 22% of consumers concerned with the health and environmental impacts of insects are more likely to be open to eating insects (Palmieri et al. 2019).

Locusts are widely consumed by the Muslim community, particularly in countries like Saudi Arabia, Yemen, and Libya. Locusts are the only insects explicitly permitted for consumption in Islam, supported by clear hadiths from the Prophet Muhammad. One hadith, narrated by Ibn Umar, states that two types of dead meat are permitted: fish and locusts. Another, by Abu Ya'fur, recounts eating locusts during military campaigns with the Prophet. While locusts are allowed, the four Sunni madhhabs hold differing opinions on the consumption of other insects. Despite the sustainable benefits of insect consumption as an alternative protein source, knowledge about the halal status of most edible insects remains limited (Suganisha et al. 2023).

Despite the potential of insects as an alternative protein source, their consumption remains limited among the Malaysian population, particularly within the Muslim community (Suganisha et al. 2023). In addition to religious and cultural concerns, the absence of a dedicated legal framework for insect consumption in Malaysia further hinders the industry's development (Suzana & Bae 2019). This makes it crucial to explore social perceptions of insect consumption, especially in light of the increasing global emphasis on sustainability. This study

aims to investigate the relationship between knowledge, acceptability, perception, and the willingness to consume Insect-Containing Food (ICF) among residents of the East Coast of Malaysia (ECM). Additionally, it aims to identify key factors that predict their willingness to adopt the ICF. The East Coast was chosen for its culturally diverse population, with a majority being Malay Muslims, offering a unique perspective on the intersection of tradition, religion, and sustainability.

MATERIALS AND METHODS

Research Population and Data Collection

While entomophagy has been documented in regions such as Sabah and Sarawak, East Malaysia (Dawood & Saikim 2025; Durst et al. 2010; Chung et al. 2002), there is limited evidence of its prevalence in the East Coast states of Peninsular Malaysia. The survey evaluating the knowledge, perception, and acceptability of insects as food was conducted across three states on the ECM: Kelantan, Terengganu, and Pahang. A total of 201 responses were collected. The selection criteria for respondents were not limited by socio-demographic factors, except for their state of origin. The online survey, created using Google Forms, was distributed over a one-month period through email, social media, and personal referrals, targeting Malaysians originally from these states, regardless of their current place of residence. However, to reduce the differences between the respondents, they must be either (i) living in one of these three states or (ii) originating from one of these three states but currently studying or working elsewhere, frequently returning to their hometowns.

Questionnaire Design

A self-administered questionnaire for this study was prepared based on previous research (Gere et al. 2017; Lombardi et al. 2019; Menozzi et al. 2017; Verbeke 2015; Woolf et al. 2019). The questionnaire was divided into four sections, each focusing on specific attributes and dimensions. Section A collected socio-demographic information, including gender, age, state of origin, ethnicity, religion, education, occupation, and income, using eight structured questions. Section B assessed knowledge of entomophagy, covering health and nutritional benefits, environmental advantages, willingness to consume insects, and factors influencing interest in eating insects. This section included five Yes or No questions and 5 Likert scale questions (on a 5-point scale), following the method of Lombardi et al. (2019) and Menozzi et al. (2017). Section C analysed participants' perceptions of insects as food, including good and bad perceptions and considerations of Halal compliance, using eight Yes or No questions from Lombardi et al. (2019) and Gere et al. (2017). Section D focused on the acceptability of ICF, examining familiarity, willingness to try, and responses to a case scenario through four Yes or No questions and 6 Likert scale questions (5-point scale), as adapted from Lammers et al. (2019) and Lombardi et al. (2019). Yes or No questions were scored as 0 (no) and 1 (yes), while Likert scale responses ranged from 1 (strongly disagree/extremely unlikely) to 5 (strongly agree/extremely likely).

Pre Test

A pilot study involving 30 respondents was conducted to evaluate the validity and reliability of the questionnaire. The validity assessment ensured that all relevant topics for the study were adequately covered in the questionnaire. Reliability was tested to determine the consistency of the responses by analysing Cronbach's alpha coefficient using Statistical Package for Social Sciences (SPSS) software (IBM). The questionnaire demonstrated high reliability, with Cronbach's alpha values exceeding the acceptable threshold of 0.7.

Data Analysis

The data collected from 201 participants were analysed using IBM SPSS Statistics version 26. The analyses conducted included descriptive analysis, cross-tabulation analysis, correlation analysis, and regression analysis. Cross-tabulation analysis, employing the chi-square test, was used to examine differences between categorical variables within the same population. Correlation analysis measured the relationship between the study variables and the willingness to consume Insect-Containing Food (ICF). Regression analysis, using Analysis of Variance (ANOVA), assessed the factors influencing the desire to consume ICF among ECM.

RESULTS AND DISCUSSION

Demographics of Respondents

Table 1 demonstrates the socio-economic and demographic data of respondents. In this study, a higher proportion of women (64.2%) participated compared to men (35.8%), which suggests that women were more inclined to engage with the topic of insects as food. This gender imbalance may reflect differences in interest or availability, which could influence the results related to perceptions and acceptability of insect-based food. The majority of respondents fell into the younger age groups, with 29.4% aged 18-24 and 23.4% aged 30-40, indicating that younger individuals were more likely to participate in the study. This trend may be relevant when considering how age influences openness to new or unconventional food sources like insects (Castro-Alija et al. 2024). Younger respondents may be more exposed to global trends, sustainability issues, and novel foods through education and media.

Table 1. Descriptive characteristics of the respondents (n = 201)

Characteristics	**Demographic Characteristics**	**Number (%)**
Gender	Male	72(35.8)
	Female	129(64.2)
Age (years)	17 and below	3(1.5)
	18-24	59(29.4)
	25-29	12(6.0)
	30-40	47(23.4)
	41-50	37(18.4)
	51-60	38(18.9)
	60 above	2.5
State	Kelantan	76(37.8)
	Terengganu	88(43.8)
	Pahang	37(18.4)
Ethnicity	Malay	197(98.0)
	Chinese	2(1.0)
	Indian	2(1.0)
Religion	Muslim	198(98.5)
	Buddhist	1(0.5)
	Hindu	2(1.0)

Level of education	Secondary school	28(13.9)
	Certificate	54(26.9)
	Diploma	13(6.5)
	Bachelor Degree	98(48.8)
	Master	7(3.5)
	PhD	1(0.5)
Employment status	Full-time employed	117(58.2)
	Part-time employed	1(0.5)
	Full-time student	50(24.9)
	Freelance	4(2.0)
	Housewife	12(6.0)
	Retiree	8(4.0)
	Unemployed	9(4.5)
Income group	No income	59(29.4)
	B40	65(32.3)
	M40	63(31.3)
	T20	12(6.0)
	No answer	2(1.0)

Interestingly, the ethnic and religious composition of the respondents closely mirrored the demographic makeup of East Coast Malaysia, with 98% identifying as Malay and 98.5% as Muslim. This homogeneity might influence the generalizability of the findings, particularly regarding cultural and religious perceptions of insect consumption, such as concerns over halal status (Sabri et al. 2023).

In terms of education, nearly half (98 respondents) of the participants held a bachelor's degree, suggesting a relatively educated sample. This could imply that the respondents have greater access to information about alternative protein sources and environmental issues, potentially influencing their knowledge and attitudes toward insect consumption (Woolf et al. 2019). Employment data revealed that 58.2% of respondents were employed full-time students. The high percentage of students, combined with their relatively young age, may suggest that this group is open to experimenting with alternative food sources due to their exposure to new ideas and trends in sustainability (Castro-Alija et al. 2024).

Income distribution was fairly even across the B40 and M40 groups, with each group representing approximately 30% of the respondents. This indicates the economic background was not a major differentiating factor among the respondents. However, nearly 30% reported no income, indicating a significant proportion of students or individuals not actively participating in the workforce. These variations in socio-economic factors could affect respondents' willingness or ability to adopt insect-based foods, particularly if they are perceived as more costly or inaccessible (Ochieng et al. 2023).

Level of Knowledge and Socio-demographic Profile

The cross-tabulation of the level of knowledge and the socio-demographic profile of respondents is displayed in Table 2. Based on the table above, a comparison has been established between socio-demographic profiles and the level of knowledge. Ethnicity, education level, and income group were found to have significant differences in responses: F = 17.794, *P<0.01* (ethnicity), F = 18.531, *P<0.05* (education level), and F = 23.384, *P<0.01* (income group). In contrast, other socio-demographic factors (gender, age, state, religion, employment status) showed no significant difference in the level of knowledge. There is a significant difference between knowledge and the socio-demographic profiles of ECM (ethnicity, educational level, and income group).

Table 2. Cross-tabulation of the level of knowledge and the socio-demographic profile of the respondents

Level of Knowledge	**High**	**Moderate**	**Low**	**Test-value**	**P**
Gender (n, %)					
Male	17 41.5	51 34.0	4 40.0	0.860	0.650
Female	24 58.5	99 66.0	6 60.0		
Age (years) (n, %)					
17 and below	0 -	3 2.0	0 -	15.974	0.192
18 - 24	11 26.8	45 30.0	3 30.0		
25 - 29	2 4.9	10 6.7	0 -		
30 - 40	11 26.8	32 21.3	4 40.0		
41 - 50	10 24.4	26 17.3	1 10.0		
51 - 60	4 9.8	33 22.0	1 10.0		
60 above	3 7.3	1 0.7	1 10.0		
State (n, %)					
Kelantan	22 53.7	51 34.0	3 30.0	5.667	.225
Terengganu	14 34.1	69 46.0	5 50.0		
Pahang	5 12.2	30 20.0	2 20.0		
Ethnicity (n, %)					
Malay	41 100.0	148 98.7	8 80.0	17.794	.001
Chinese	0 -	1 0.7	1 10.0		
Indian	0 -	1 0.7	1 10.0		
Religion (n, %)					
Muslim	41 100.0	148 98.7	9 90.0	9.143	0.058
Buddhist	0 -	1 0.7	0 -		

Hinduism	0	1	1		
	-	0.7	10.0		
Level of education (n, %)					
Secondary school	6	20	2	18.531	0.047
	20.0	13.3	20.0		
Certificate	2	11	0		
	4.9	7.3	-		
Diploma	12	37	5		
	29.3	24.7	50.0		
Bachelor Degree	16	80	2		
	39.0	53.3	20.0		
Master	4	2	1		
	9.8	1.3	10.0		
PhD	1	0	0		
	2.4	-	-		
Employment status (n, %)					
Full-time employed	24	87	6	6.595	0.883
	58.5	58.0	60.0		
Part-time employed	0	1	0		
	-	0.7	-		
Full-time student	10	38	2		
	24.4	25.3	20.0		
Freelance	1	3	0		
	2.4	2.0	-		
Housewife	4	7	1		
	9.8	4.7	10.0		
Retiree	2	5	1		
	4.9	3.3	10.0		
Unemployed	0	9	0		
	-	6.0	-		
Income group (n, %)					
No income	11	47	1	23.384	0.009
	26.8	31.8	10.0		
B40	11	51	5		
	26.8	34.0	40.0		
M40	16	43	4		
	39.0	29.1	40.0		
T20	3	9	0		
	7.3	6.1	-		

Ethnicity may be related to cultural experiences applied in daily life, which are shaped by socio-demographic factors. It has been proven to be a significant factor influencing willingness to consume insect-based food. Studies found that differing ethnicities and cultures in Western and Asian countries influenced their favorability ratings toward insect-based food (Chia et al. 2024; Tan et al. 2020). The culture of ethnicity affects attitudes, beliefs, and the social appeal of food consumption (Jeong & Lee 2021). Olivadese and Dindo (2023) It was also identified that cultural barriers pose a significant challenge to fostering entomophagy. A proactive measure by Sogari et al. (2018) introduced cultural aspects of entomophagy to participants, providing essential information on the topic, given their limited knowledge.

Moreover, education levels can also be crucial in influencing knowledge of entomophagy, which in turn impacts the acceptance of insects as food. Woolf et al. (2019) recommended education and exposure to insect consumption to improve consumer willingness to eat ICF. However, the extent of education did not necessarily influence the willingness to try insects, as found in previous studies (Tan 2017; Tan et al. 2017; Tan & House 2018; Verbeke 2015). The income group also showed a significant difference. Patel et al. (2019) argued that entomophagy has been a common practice among low-income groups in many countries. The necessity for dietary supplements has led to insects being integrated into their diets for generations, making it an inherent habit. However, Ochieng et al. (2023) found that members of higher-income groups consumed more insects compared to those with lower incomes.

Level of Perception and Socio-demographic Profile

Based on Table 3, a comparison was made between the socio-demographic profiles and the level of perception. The results showed that only the level of education had a significant difference in responses: F = 19.926, $P<0.01$ (level of education). Other socio-demographic factors (gender, age, ethnicity, religion, employment status, and income group) showed no significant differences in relation to the level of perception.

Table 3. Cross-tabulation of the level of perception and the socio-demographic profile of the respondents

Level Of Perception	**Positive**	**Negative**	**Test-Value**	**P**
Gender (n, %)				
Male	30 38.0	42 34.4	.263	0.608
Female	49 62.0	80 65.6		
Age (years)				
17 and below	3 3.8	0 -	12.464	0.052
18 - 24	22 27.8	37 30.3		
25 - 29	7 8.9	5 4.1		
30 - 40	14 17.7	33 27.0		
41 - 50	16 20.3	21 17.2		
51 - 60	13 16.5	25 20.5		
60 above	4 5.1	1 0.8		
State				
Kelantan	32 40.5	44 36.1	0.990	0.609
Terengganu	35 44.3	53 43.4		
Pahang	12 15.2	25 20.5		
Ethnicity				
Malay	77 97.5	120 98.4	4.388	0.111

Chinese	2 2.5	0 -		
Indian	0 -	2 1.6		
Religion				
Muslim	78 98.7	120 98.4		
Buddhist	1 1.3	0 -		
Hinduism	0 -	2 1.6		
Level of education				
Secondary school	18 22.8	10 8.2	19.926	0.001
Certificate	7 8.9	6 4.9		
Diploma	12 15.2	42 34.4		
Bachelor Degree	36 45.6	62 50.8		
Master	5 6.3	2 1.6		
PhD	1 1.3	0 -		
Employment status				
Full-time employed	43 54.4	74 60.7	9.447	0.150
Part-time employed	1 1.3	0 -		
Full-time student	20 25.3	30 24.6		
Freelance	3 3.8	1 0.8		
Housewife	3 3.8	9 7.4		
Retiree	9 7.4	2 1.6		
Unemployed	12 6.0	6 4.9		
Income group				
No income	20 25.3	39 32.5	6.984	0.222
B40	28 35.4	37 30.3		
M40	29 36.7	29 36.7		
T20	2 2.5	10 8.3		

The findings of this study align with the study by Meludu and Onoja (2018), which demonstrated that education level was positively associated with the positive perception of edible insects, as higher education levels often lead to greater openness to new food innovations.

However, contrary to the results, Florença et al. (2021) found no association between education level and perceptions of edible insects, suggesting that the influence of education level may vary across regions and cultures. Anagonou et al. (2023) highlighted that ethnicity and religion play crucial roles in shaping perceptions of entomophagy, with specific ethnic and religious groups expressing negative views on insect consumption. This contrast underscores the complex interplay of socio-demographic factors in shaping perceptions, which can vary depending on cultural context and exposure to formal education.

Level of Acceptability and Socio-demographic Profile

Based on Table 4, a comparison has been established between socio-demographic profiles and the level of acceptability. Gender, age, and state of residence were found to have significant differences in responses: F = 5.312, $P<0.05$ (gender), F = 18.475, $P<0.01$ (age), and F = 9.631, $P<0.01$ (state of residence). However, other socio-demographic factors, including religion, employment status, education level, ethnicity, and income group, showed no significant differences in the level of acceptability. Therefore, there is a significant difference in acceptability based on the socio-demographic profile of ECM (gender, age, and state of residence).

Table 4. Cross-tabulation of the level of acceptability and the socio-demographic profile of the respondents

Level of Acceptability	**High**	**Low**	**Test-value**	**P**
Gender (n, %)				
Male	21	51	5.312	0.021
	51.2	31.9		
Female	20	109		
	48.8	68.1		
Age (years)				
17 and below	3	0	18.475	0.005
	7.3	-		
18 - 24	10	49		
	24.4	30.6		
25 - 29	1	11		
	2.4	6.9		
30 - 40	10	37		
	24.4	23.1		
41 - 50	6	31		
	14.6	19.4		
51 - 60	8	30		
	19.5	18.8		
60 above	3	2		
	7.3	1.3		
State				
Kelantan	24	52	9.631	0.008
	58.5	32.5		
Terengganu	11	77		

	26.8	48.1		
Pahang	6	31		
	14.6	19.4		
Ethnicity				
Malay	41	156	1.046	0.593
	100.0	97.5		
Chinese	0	2		
	-	1.3		
Indian	0	2		
	-	1.3		
Religion				
Muslim	41	157	0.780	0.677
	100.0	98.1		
Buddhist	0	1		
	-	0.6		
Hinduism	0	2		
	-	1.3		
Level of education				
Secondary school	9	19	5.892	0.317
	22.0	11.9		
Certificate	3	10		
	7.3	6.3		
Diploma	9	45		
	22.0	28.1		
Bachelor Degree	17	81		
	41.5	50.6		
Master	3	4		
	7.3	2.5		
PhD	0	1		
	-	0.6		
Employment status				
Full-time employed	21	96	7.140	0.308
	51.2	60.0		
Part-time employed	0	1		
	-	0.6		
Full-time student	11	39		
	26.8	24.4		
Freelance	0	4		
	-	2.5		
Housewife	2	10		
	4.9	6.3		
Retiree	4	4		
	9.8	2.5		

Unemployed	3	6		
	7.3	3.8		
Income group				
No income	13	46	2.963	0.706
	31.7	29.1		
B40	11	54		
	26.8	33.8		
M40	16	47		
	39.0	29.7		
T20	1	11		
	2.4	7.0		

A frequent topic in relation to the acceptance of entomophagy is gender. According to Florença et al. (2022), females tend to have lower acceptability toward entomophagy compared to males, as they exhibit higher aversions to insects. Previous studies have also shown that men are generally more adventurous when trying new foods, displaying a more positive attitude than women (Florença et al. 2022; Tan 2017; Verbeke 2015;). Gere et al. (2017) further reported that men were more willing to eat insects compared to women, who tend to be more neophobic. There was also a significant difference in age groups regarding the acceptance of insects as a food source. This finding aligns with Gere et al. (2017), who observed a positive correlation between age and food-related attitudes in their Belgian sample. However, Białek-Dratwa et al. (2024) found no significant impact of age on food neophobia, contrasting with Hazley et al. (2022), which showed that older people exhibited higher levels of food neophobia. Hazley et al. (2022) also stated that food neophobia increased from ages 1 to approximately 6 years, then declined until early adulthood, where it stabilised before rising again in older adults (over 54 years).

The state of residence also showed a significant difference in the acceptability of entomophagy, which may be attributed to varying cultural experiences and food traditions across different states. The acceptance of unfamiliar foods often relates to one's familiarity with such practices in daily life. In Kelantan, for instance, grasshoppers have been reported as a delicacy and were once sold in local markets, suggesting a degree of traditional entomophagy. However, limited formal documentation or recent data detailing the extent and frequency of insect consumption in Kelantan, Terengganu, or Pahang highlights the need for further research into region-specific entomophagy practices. Hartmann et al. (2015) analysed the cross-regional acceptance of insect-based products between China and Germany, highlighting that familiarity plays a crucial role in acceptance. Germans, for instance, were more reluctant to accept insects as food due to their lack of exposure, whereas Chinese respondents were more familiar with the practice. Additionally, regions or states may exhibit differing food preferences, which can influence their acceptance of insects as a food source. By incorporating insects into familiar dishes, the likelihood of acceptance increases. Germans were more willing to consume insects when they were included in familiar processed foods, such as cookies. At the same time, Chinese participants showed no preference between processed and unprocessed insects, likely due to their existing familiarity with the practice (Hartmann et al. 2015).

Willingness to Consume Insect-Containing-Food (ICF)

The relationships between knowledge, acceptability, and perception regarding the willingness to consume ICF among ECM are presented in Table 5. The analysis indicates significant relationships between knowledge (r = .654, *P<0.01*), acceptability (r = .336, *P<0.01*), and perception (r = .422, *P<0.01*) with the willingness to consume ICF. Further regression analysis was conducted to identify factors predicting the knowledge, perception, and acceptability of insect-based food among ECM. This study found a relationship between knowledge, perception, and acceptability, as well as the willingness to consume ICF, among ECMs.

Table 5. The relationship between the KAP and the willingness to consume ICF among ECM

Variables	r-value
	Willingness to consume ICF
Knowledge	0.654**
Perception	0.336**
Acceptability	0.422**

**Correlation is significant at the 0.001 level (2-tailed).

Knowledge significantly influences the willingness to consume ICF, consistent with previous research. Woolf et al. (2019) reported that increased knowledge, particularly regarding the nutritional value, environmental benefits, and safety of consumption, positively impacted participants' willingness to eat ICF, as they were more likely to consume it when aware of its benefits. Although individuals who had previously tried insects possessed some knowledge of entomophagy, this did not significantly influence their willingness to try whole insect foods (Orsi et al. 2019). However, prior knowledge and experience with insects did positively affect taste ratings for insect burgers (Megido et al. 2016). This result aligns with Pambo et al. (2018), which highlighted that greater knowledge of entomophagy could positively affect ICF consumption.

Perceptions also significantly impact the willingness to consume ICF, as many studies have emphasised (Hartmann et al. 2015; Nyberg et al. 2020; Verbeke 2015). Perception of entomophagy is primarily influenced by exposure (Woolf et al. 2019). Early exposure to ICF tends to improve perceptions of entomophagy, making consumers more willing to eat insects. Pambo et al. (2016) found that 88% of participants who had been exposed to ICF accepted insects as a food source. Interestingly, knowledge and information about insect consumption practices also affected consumer perceptions (Hartmann et al. 2015; Megido et al. 2016; Orsi et al. 2019; Tan et al. 2017).

CONCLUSIONS

This study assessed the knowledge, acceptability, and perception of insect consumption among East Coast Malaysians (ECM). Results showed 60.7% of respondents had a negative perception of insects as food, and 79.6% demonstrated low acceptability, with significant socio-demographic differences in knowledge and acceptability. The negative perception and low acceptability were largely attributed to beliefs that insects are disgusting, unsafe for consumption, potentially disease-carrying, lacking nutritional value, and unlikely to be delicious. Some respondents also viewed insects as unsuitable for human consumption. A

positive relationship was found between knowledge, perception, and willingness to consume insect-containing foods (ICF), with these factors being significant predictors of ICF consumption. The study highlights the need for public education to improve awareness of the safety, nutritional value, and environmental benefits of ICF, as well as to address common concerns such as halal status. It is essential to recognise that the presentation of insects in the questionnaire may have influenced participant responses. Without contextual framing or examples of edible insect-based products (e.g., protein bars, powders), some respondents may associate insects solely with pests, thereby reinforcing negative perceptions of them. Future studies should consider including basic educational information or product examples to support more informed and accurate evaluations of ICF acceptability.

AUTHORS DECLARATIONS

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Conflict of Interest
No potential conflict of interest was reported by the author(s).

Ethics Declarations
Ethical approval was not available for this study. Nevertheless, although it involved minimal risk and no sensitive personal data, the study adhered to ethical research standards by ensuring voluntary participation and obtaining informed consent from all respondents prior to their involvement in the survey.

Data Availability Statements
Data will be made available on request.

Author's Contributions
Nur Zulaikha Kamaruzaman (NZK): Writing – original draft, Conceptualisation, Methodology, Software, Formal analysis, Investigation, Resources, Data Curation. Tan Yi-Li (TYL): Methodology, Software, Formal analysis, Investigation, Resources, Data Curation. Nurul Hanisah Juhari (NHJ): Writing – review & editing, Supervision. Abd Rahim Muhamad Hafiz (ARMH): Writing – review & editing, Supervision. Mohammad Rashedi Ismail-Fitry (MRIF): Conceptualisation, Validation, Writing – review & editing, Supervision, Project administration, Funding acquisition.

REFERENCES

Anagonou, C.M., Loko, L.E.Y., Dassou, A.G., Toffa, J., Djegbe, I., Saliou, M. & Dansi, A. 2023. Entomophagy practices, use patterns, and factors influencing perception and consumption frequency of edible insects in the Republic of Benin. *Journal of Ethnobiology and Ethnomedicine* 19(1): 54.

Benoit, M. & Mottet, A. 2023. Energy scarcity and rising cost: Towards a paradigm shift for livestock. *Agricultural Systems* 205(February): 103585.

Białek-Dratwa, A., Sta´skiewicz-Bartecka, W., Kiciak, A., Wardyniec, A., Grajek, M., Aktaç, S., Çelik, Z.M., et al. 2024. Food neophobia and avoidant/restrictive food intake among adults and related factors. *Nutrients*16(17): 2952.

Carrigan, M., Wells, V.K. & Papadas, K.A. 2023. Research Handbook on Ethical Consumption: Contemporary Research in Responsible and Sustainable Consumer Behaviour, pp. 1–396. Cheltenham: Edward Elgar Publishing.

Castro-Alija, M.J., Zolfaghari, G., Gutierrez Fernandez, C., Álvarez, C., Ramón-Carreira, L.C., Jiménez, J.M. & Albertos, I. 2024. Elderly resistance vs. youthful acceptance: A study on insect consumption across age groups. *Foods* 13(16): 2641.

Chia, A., Shou, Y., Wong, N.M.Y., Cameron-Smith, D., Sim, X., Van Dam, R.M. & Chong, M.F.F. 2024. Complexity of consumer acceptance to alternative protein foods in a multiethnic Asian population: A comparison of plant-based meat alternatives, cultured meat, and insect-based products. *Food Quality and Preference* 114 (May): 105102.

Chung, A.Y.C., Khen, C.V., Unchi, S. & Momin. 2002. Edible insects and entomophagy in Sabah, Malaysia. *Malaysia Nature Journal 56*(2): 131–144.

Cunha, N., Andrade, V., Ruivo, P. & Pinto, P. 2023. Effects of insect consumption on human health: A systematic review of human studies. *Nutrients* 15(14): 3076.

Dawood, M.M. & Saikim, F.H. 2025. Insects as natural resources in the food and tourism industry: From global to local. *Borneo Science The Journal of Science and Technology* 46(1): 1-12.

Durst, P.B., Johnson, D.V., Leslie, R.N. & Shono, K. 2010. Forest insects as food: Human bite back. *Proceedings of a Workshop on Asia-Pacific Resources and Their Potential for Development*, pp. 231.

Fairuz Liyana, M.R., Ishak, A.R., Hua, P.W., Mohamad Shaifuddin, S.N., Dom, N.C., Abdul Kari, Z., Mohd Yatim, S.R., Atan Edinur, H., Megat Mokhtar, M.A. & Md Rashid, R.I. 2023. Evaluating the growth and development of Black Soldier Fly (BSF) (*Hermetia illucens* (L.) (Diptera: Stratiomyidae) larvae reared on different agricultural waste materials. *Serangga* 28(1): 55–68.

Florença, S.G., Correia, P.M.R., Costa, C.A. & Guiné, R.P.F. 2021. Edible insects: Preliminary study about perceptions, attitudes, and knowledge on a sample of Portuguese citizens. *Foods* 10(4): 709.

Florença, S.G., Guiné, R.P.F., Gonçalves, F.J.A., Barroca, M.J., Ferreira, M., Costa, C.A., Correia, P.M.R., et al. 2022. The motivations for consumption of edible insects: A systematic review. *Foods* 11(22): 3643.

Fuso, A., Leni, G., Prandi, B., Lolli, V. & Caligiani, A. 2024. Novel foods/feeds and novel frauds: The case of edible insects. *Trends in Food Science and Technology* 147: 104457.

Gere, A., Székely, G., Kovács, S., Kókai, Z. & Sipos, L. 2017. Readiness to adopt insects in Hungary: A case study. *Food Quality and Preference* 59(July): 81–86.

Gier, S.d. & Verhoeckx, K. 2018. Insect (food) allergy and allergens. *Molecular Immunology* 100(August): 82–106.

Gunggot, E. & Lardizabal, M.L. T. 2024. Assessing the efficiency of the black soldier fly (*Hermetia illucens* L.) larvae as bioconversion agent for ground banana peels. *Serangga* 29(2): 150–159.

Hartmann, C., Shi, J., Giusto, A. & Siegrist, M. 2015. The psychology of eating insects: A cross-cultural comparison between Germany and China. *Food Quality and Preference* 44(September): 148–56.

Hazley, D., Stack, M., Walton, J., McNulty, B.A. & Kearney, J.M. 2022. Food neophobia across the life course: Pooling data from five national cross-sectional surveys in Ireland. *Appetite* 171(April): 105941.

Hernández-álvarez, A.J., Nosworthy, M.G & Mondor, M. 2022. Amino acid profile and bioavailability of plant-based protein-rich products. In *Plant Protein Foods*, pp. 343–379. Cham: Springer.

Husna, F., Ahmad, H., Kura, I.S., Ishak, I.H. & Salim, H. 2023. The potential of mealworm (*Tenebrio molitor*) and field cricket (*Gryllus assimilis*) as alternative nutrient sources in ruminant feed production. *Serangga* 28(3): 1–18.

Jeong, S. & Lee, J. 2021. Effects of cultural background on consumer perception and acceptability of foods and drinks: A review of latest cross-cultural studies. *Current Opinion in Food Science* 42(December): 248–56.

Jongema, Y. 2017. Worldwide list of edible insects. https://www.wur.nl/en/research-results/chair-groups/plant-sciences/laboratory-of-entomology/edible-insects/worldwide-species-list.htm [15 September 2024].

Lammers, P., Ullmann, L.M. & Fiebelkorn, F. 2019. Acceptance of insects as food in Germany: Is it about sensation seeking, sustainability consciousness, or food disgust? *Food Quality and Preference* 77(October): 78–88.

Lombardi, A., Vecchio, R., Borrello, M., Caracciolo, F. & Cembalo, L. 2019. Willingness to pay for insect-based food: The role of information and carrier. *Food Quality and Preference* 72(March): 177–87.

Ma, Z., Mondor, M., Goycoolea Valencia, F. & Hernández-Álvarez, A.J. 2023. Current state of insect proteins: Extraction technologies, bioactive peptides and allergenicity of edible insect proteins. *Food & Function* 14(18): 8129–56.

Megido, R.C., Gierts, C., Blecker, C., Brostaux, Y., Haubruge, É., Alabi, T. & Francis, F. 2016. Consumer acceptance of insect-based alternative meat products in Western countries. *Food Quality and Preference* 52(September): 237–43.

Meludu, N.T. & Onoja, M.N. 2018. Determinants of edible insects consumption level in Kogi State, Nigeria. *Journal of Agricultural Extension* 22(1): 156–70.

Menozzi, D., Sogari, G., Veneziani, M., Simoni, E. & Mora, C. 2017. Eating novel foods: An application of the theory of planned behaviour to predict the consumption of an insect-based product. *Food Quality and Preference* 59(July): 27–34.

Mohd Zaini, N.S., Lim, E.J., Ahmad, N.H., Gengatharan, A., Wan Abd Al Qadr Imad Wan-Mohtar & Abd Rahim, M.H. 2023. The review of cooking, drying, and green extraction methods on general nutritional properties of mealworms and locusts. *Food and Bioprocess Technology* 16(9): 1904-1918.

Nadathur, S., Wanasundara, J.P.D., Marinangeli, C.P.F. & Scanlin, L. 2024. Proteins in our diet: Challenges in feeding the global population. In Nadathur, S., Wanasundara, J.P.D. & Scanlin, L. (eds.). *Sustainable Protein Sources*, pp. 1-29. Cambridge: Academic Press.

Nyberg, M., Olsson, V. & Wendin, K. 2020. Reasons for eating insects? Responses and reflections among Swedish consumers. *International Journal of Gastronomy and Food Science* 22(December): 100268.

Ochieng, O.K., Mukhebi, A. & Orinda, M. 2023. Effects of social, cultural and economic factors on consumption of edible insects for household food security. *East African Journal of Arts and Social Sciences* 6(1): 39–53.

Olivadese, M & Dindo, M.L. 2023.Edible insects: A historical and cultural perspective on entomophagy with a focus on Western societies. *Insects* 14(8): 690

Orsi, L., Voege, L.L. & Stranieri, S. 2019. Eating edible insects as sustainable food? Exploring the determinants of consumer acceptance in Germany. *Food Research International* 125(November): 108573.

Palmieri, N., Perito, M.A., Macrì, M.C. & Lupi, C. 2019. Exploring consumers' willingness to eat insects in Italy. *British Food Journal* 121(11): 2937–50.

Pambo, K.O., Okello, J.J., Mbeche, R.M., Kinyuru, J.N. & Alemu, M.H. 2018. The role of product information on consumer sensory evaluation, expectations, experiences and emotions of cricket-flour-containing buns. *Food Research International* 106(April): 532–41.

Pambo, K.O., Okello, J.J., Mbeche, R. & Kinyuru, J.N. 2016. Consumer acceptance of edible insects for non-meat protein in Western Kenya. *Presentation at the 5th African*

Association of Agricultural Economists (AAAE) Conference at the United Nations Conference Center, Addis Ababa-Ethiopia, 23-26 September 2016, pp. 1-19.

Patel, S., Suleria, H.A.R. & Rauf, A. 2019. Edible insects as innovative foods: Nutritional and functional assessments. *Trends in Food Science & Technology* 86(April): 352–59.

Ruby, M.B. & Rozin, P. 2019. Disgust, sushi consumption, and other predictors of acceptance of insects as food by Americans and Indians. *Food Quality and Preference* 74(June): 155–62.

Sabri, N.S.A., Kamardan, M.I.F., Wong, S.X., Azman, N.F., Md Akhir, F.N., Othman, N., Awang, N., Kuroki, Y. & Hara, H. 2023. Future aspects of insects' ingestion in Malaysia and Indonesia for human well-being and religion regulation. *Future Foods* 8(December): 100267.

Siddiqui, S.A., Tettey, E., Yunusa, B.M., Ngah, N., Debrah, S.K., Yang, X., Fernando, I., Povetkin, S.N. & Shah, M.A. 2023. Legal situation and consumer acceptance of insects being eaten as human food in different nations across the world–A comprehensive review. *Comprehensive Reviews in Food Science and Food Safety* 22(6): 4786–4830.

Sogari, G., Liu, A. & Li, J. 2018. Understanding edible insects as food in Western and Eastern societies. In Bogueva, D., Marinova, D., Raphaely, T. & Schmidinger, K. (eds.). *Environmental, Health, and Business Opportunities in the New Meat Alternatives Market*, pp. 166–81. Hershey, PA: IGI Global Scientific Publishing.

Suganisha, S., Mohd Zaini, N.S., Abd Rahim, M.H. & Ahmad, N.H. 2023. Insects and worms as an alternative protein source in the halal food industry. In Nizar, N.N.A., Abidin, S.A.S.Z. & Bujang, A. (eds.). *Innovation of Food Products in Halal Supply Worldwide*, pp. 127-148. London: Academic Press.

Suzana, M.S. & Bae, Y.J. 2019. Legislation to foster and support the insect industry: Something for Malaysia to ponder. *Serangga* 24(2): 90–103.

Tan, C.Y., Song, M., Hong, K.J., Lin, J., Yap, K. & Natsume, T. 2020. Food tech: Alternative protein opportunities in Asia October. https://www.insead.edu/sites/default/files/assets/dept/centres/gpei/docs/food-tech-alternative-protein-opportunities-in-asia.pdf [22 July 2024].

Tan, H.S.G. 2017. Eating insects: Consumer acceptance of a culturally inappropriate food. PhD thesis, Wageningen University, Wageningen, NL.

Tan, H.S.G. & House, J. 2018. Consumer acceptance of insects as food: Integrating psychological and socio-cultural perspectives. In Halloran, A., Flore, R., Vantomme, P. & Roos, N. (eds.). *Edible Insects in Sustainable Food Systems,* pp. 375–86. Cham: Springer International Publishing.

Tan, H.S.G., Verbaan, Y.T. & Stieger, M. 2017. How will better products improve the sensory-liking and willingness to buy insect-based foods? *Food Research International* 92(February): 95–105.

Verbeke, W. 2015. Profiling consumers who are ready to adopt insects as a meat substitute in a Western society. *Food Quality and Preference* 39(January): 147–55.

Videbæk, P.N. & Grunert, K.G. 2020. Disgusting or delicious? Examining attitudinal ambivalence towards entomophagy among Danish consumers. *Food Quality and Preference* 83(July): 103913.

Wendin, K., Olsson, V. & Langton, M. 2019. Mealworms as food ingredient—Sensory investigation of a model system. *Foods* 8(8): 319.

Woolf, E., Zhu, Y., Emory, K., Zhao, J. & Liu, C. 2019. Willingness to consume insect-containing foods: A survey in the United States *LWT* 102(March): 100–105.

Wu, Q., Patočka, J. & Kuča, K. 2018. Insect antimicrobial peptides, a mini review. *Toxins* 10(11): 461.

Yi, H.Y., Chowdhury, M., Huang, Y.D. & Yu, X.Q. 2014. Insect antimicrobial peptides and their applications. *Applied Microbiology and Biotechnology* 98(13): 5807–22.

Zhao, J.G., Wang, H.Y., Wei, Z.G. & Zhang, Y.Q. 2019. Therapeutic effects of ethanolic extract from the green cocoon shell of silkworm *Bombyx mori* on type 2 diabetic mice and its hypoglycaemic mechanism. *Toxicology Research* 8(3): 407–20.