

# Food Security Through Entomophagy

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## ABSTRACT

Due to burgeoning populations, income growth, employment, and urbanization trends, food security had become a global concern. Entomophagy is a process of consuming edible insects that had been chosen as an alternative food source to solve the issues of food security. This study aimed to examine the effect of factors related to the product, social trust and norms, and psychological factors on consumers' acceptance towards entomophagy. The number of samples to be taken is 100 respondents with a convenience sampling method. Data was collected using a questionnaire and then analyzed using Partial Least Square-Structural Equation Modelling (PLS-SEM). The results show that factors related to the product and psychological factors affect consumers' acceptance towards entomophagy, while on the contrary, social trusts and norms do not affect consumers' acceptance towards entomophagy.

**Keywords:** *Consumer acceptance, Entomophagy, Edible insects, Food security, Indonesia*

## 1. INTRODUCTION

Food security is now becoming a global concern due to burgeoning populations, income growth, employment, and urbanization trends. Natural resources decrease as demand for food increases. According to [1], the world's population is anticipated to reach 9 billion by 2050 and this would result in an increase in the demand for food by nearly 70 percent. More than ever, nations worldwide are feeling increasing pressure to improve the food system.

Besides, external factors such as climate change and environmental pollution have also caused a negative impact and led to the sustainability of animal-based food supply such as meat, fish, milk, and eggs [2]. Furthermore, animal-based farming requires a lot of lands and contributes to global greenhouse gasses (GHG) emissions [3]. To overcome the food crisis, companies and governmental agencies have implemented various methods to improve food supply by introducing new technologies that are more efficient, cost-effective, and yield better crops such as genetically-modified foods [4]. However, food insecurity is still a common problem among low-income households in developing countries including Indonesia. Given this phenomenon, the Food and Agriculture Organization (FAO) of the United Nations took an initiative to create a policy and proposed the program of feeding people with alternative sources including insects [5].

Entomophagy is defined as the process of consuming edible insects as an alternative food source [6] [7]. Studies show that back to ancient times, people in South Africa, the United States, and Spain have eaten ants, beetle larvae, lice, ticks, termites, and mites [8]. Although the concept of entomophagy is considered new when being compared with traditional meat consumption or vegetarian trend, it has

been around for over a century. At present, the edible insects are common either as street food, snacks, or part of a meal to many ethnic groups in Asia, Africa, Mexico, and South America [9].

Edible insects are nutritious, readily-available, and leave less carbon footprint compared to livestock [7]. More than 1,900 insect species are proven to be edible and constituting traditional diets for over 2 billion people [1]. Globally, the beetle is the most commonly-consumed insect (31%); followed by caterpillars (18%), bees, wasps, and ants (14%); grasshoppers, locusts, and crickets (13%); cicadas, leafhoppers, planthoppers, scale insects and true bugs (10%); termites (3%), dragonflies (3%), flies (2%) and others (5%) [1].

Nonetheless, it is argued that the notion of edible insects was not always welcomed, especially in the Western countries as it is viewed as disgusting, and entomophagy is perceived as the act of primitive people [1]. This mentality is difficult but not impossible to change. Due to the increasing awareness of food security issues globally, more and more people in the West have started to slowly embrace entomophagy. One such example is the introduction of insects such as canned ants and fried grasshoppers in exotic food stores in Europe and the United States [2] [7].

There are various advantages to entomophagy. Firstly, edible insects derive from natural resources. Insects can be easily found in forests and water resources. In developing and under-developed countries, insects are readily available whereby the people can collect insects to support their family meals in an inexpensive way to meet their daily nutritional needs. Secondly, entomophagy has economical reproduction whereby the insects can be populated in small spaces and within a short-period [10]. This is due to the

insects' short lifespan and high growth-rate. Furthermore, insects do not require huge amounts of feed, unlike livestock [11].

Thirdly, edible insects provide healthy and nutritional benefits. These insects can act as a supplementary ingredient for making bread or porridge and they contain high nutritional values [12]. Apart from this, edible insects provide proteins, calcium, and vitamins to the human bodies [10]. For example, studies found that some of these edible insects contain a higher amount of protein compared to meat or fish [13]. Also, edible insects have long been used by Aborigine tribes as a medical treatment. For example, in China, insects like bees act as nutritional ingredients and are processed into various tonics or healthy foods. Besides, The State Food and Drug Administration and State Health Ministry of China have also approved more than 30 ant-containing health products to be sold in the Chinese market [7].

Next, entomophagy has environmental benefits as insect farming is more environmental-friendly compared to livestock farming [14]. Furthermore, the farming of edible insects indirectly contributes to the reduction of pesticide usage in comparison to agriculture farming [13]. Lastly, entomophagy is a good source of economic contribution that can help the livelihood and socio-economic situation of the area. Locals can generate income by cultivating, collecting, and selling cooked edible insects like crickets and grasshoppers to be sold as street food [1]. Street food is a growing gastronomical trend due to the growth in rural tourism development [15].

Previous research regarding entomophagy has primarily focused on the benefits and risks concerning the consumption of insects as food in Western countries [10]. Furthermore, studies within the field of consumer behavior regarding the consumption of insect-based products have tended to focus mainly on consumers' receptiveness and readiness to consume insect-based products rather than on individuals' consumption acceptance experience and the factors contributing to the formation of these intentions [16] [17]. According to the Malaysian Islamic Development (JAKIM) Director (Halal Hub Division), Hakimah Mohd Yusoff, the insects including pests, flies, lice, and so on are considered repulsive and hence are not allowed [18].

Another misconception is that although the existing literature concedes that entomophagy is prevalent in Asian countries, individual countries were not studied in detail. Very little is known about the present consumption intentions of Indonesian consumers towards insects. In Indonesia, there are differences of opinion about insects as food, but they can be eaten as medicine [19][20]. Many past studies conducted in the context of food consumption were related to organic food [21] [22], green food [23], and genetically-modified food [24] [25] [26]. There is still a lack of empirical research carried out on edible insects which endows this study with an academic value to contribute to the knowledge gap in the specific area of consumer acceptance of edible insects. Therefore, this study aimed to

investigate the perceptions towards consuming edible insects, through several concentrated interviews. Also, this study would explore the factors driving the perception of customers towards edible insects and suggest people who attempt to promote their acceptance.

This study would enable us to gain valuable insights into the underlying factors influencing consumers' acceptance towards the consumption of insects that could help companies to develop and market insects and insect-based products successfully. Marketers can make use of the knowledge acquired from the outcomes of this study to develop consumer-appealing approaches in terms of insect-based product development and marketing. Furthermore, a new level of awareness concerning the benefits of entomophagy can be developed to mitigate dire food security issues across different countries.

Globally, 800 million out of 7.6 billion people suffer from hunger. In other words, one out of ten people is suffering from hunger. It's also estimated that by 2050, the world population is expected to reach 9.2 billion, therefore, to ensure food availability by 2050, the world needs to increase 70% of its food production. United Nation reported that Asia faces an unprecedented food crisis and food security is an issue that needs serious attention, especially in a developing country such as Indonesia. Food security determines the availability of food for the population in the country, and as the population grows in Indonesia, major crops and food items become scarce. According to the Global Food Security Index 2019, Indonesia is ranked as number 62 out of 113 countries. Furthermore, Food Security is ranked number 2 among the 17 sustainable development goals in the United Nations 2030 Development Agenda.

Thus, new and sustainable food systems have to be established to ensure an environmentally-friendly provision of healthy proteins. Replacing parts of the proteins obtained through the consumption of meat with insect-based substitutes thereby represents a strategic approach that would meet the challenges of developing sustainable food systems [1] [6]. Consumers, however, remain averse towards a class of items that are not traditionally considered to be food. Preference of edible insect species differs as per taste, nutritional value, ethnic customs, local prohibition, family background, and easy availability [1]. In 1999, [27] argued that the origin of this phenomenon lies in the existence of a major attitudinal barrier towards the consumption of insects in Western societies, whereas [28] claimed that this barrier is mainly caused by cultural factors.

## **2. THEORETICAL BACKGROUND**

### *2.1. Consumer Acceptance*

Consumer acceptance is a broad concept; there is no single theory that can explain why consumers do or do not accept a product [2]. Consumer acceptance can be used in different fields; in this study, it is applied to the field of innovative food technologies and food products, as described by [29].

Insects can be seen as a new or innovative type of food in Indonesia, although it should be kept in mind that various products can be made with insects or insect-based ingredients. Insects by most Malaysians are considered as a re-emerging food, although it is common to the communities that stay in the Borneo Island such as Sabah and Sarawak. People may consume insects without realizing it such as in food coloring agent E120, candy, yogurt, and alcoholic beverage. Insects are also being researched as a food additive [30]. Not just “one type of food”, insects can also be a delicacy and an ingredient [2].

Consumer acceptance of innovative food technologies and products largely depends on how they perceive these products [2]. [31] reported that these perceptions form consumer attitudes that ultimately shape their consumption behavior (acceptance or rejection of edible insect in this case). In this study setting, the consumer, who may view the foods from edible insects as new (re-emerging) foods, faces a portfolio-type-consumption decision problem [32]. When foods from edible insects are available, the consumer decides whether to accept or reject them. The decision, as explained by [31], is not ‘either-or’ in nature, but the consumer simultaneously goes through a complex factor-evaluation process.

In Figure 1, an overview of factors influencing the consumer acceptance of entomophagy is provided. Consumer acceptance of innovative food technologies can be influenced by three factors, namely factors related to the product, social trusts and norms, and psychological factors [29]. The model developed by [29] focuses on the consumer acceptance of new food technologies and products in general. These three factors have been added to the figure [28] [33] [34] [35]. In this study, we examined the factors influencing consumer acceptance towards entomophagy.

## *2.2. The impact of factors related to the product on consumer acceptance towards entomophagy*

The literature review shows three factors that are expected to play a role under those related to entomophagy: (1) Price, (2) Perceived benefit (Halalness), and (3) Perceived naturalness. The first factor is the price whereas it is important to consumers for a “reasonably” priced and good quality product [29] [33]. High adoption costs and being lack of knowledge by potential adopters appear to be the common barriers in the utilization of new technologies including innovative food technologies and products [36]. Second, consumer acceptance can be influenced by tangible product benefits. However, the benefits need to be known by consumers to increase the chance for them to accept the new product [29] [34]. Indonesia has a diverse population with different religions and races. Another concern of food consumption is about the halal issues. With the immense number of citizens in Indonesia consisting of the Muslim population, the food products will require Halal certification. The concept of Halal as specified consists of values like nutritious, quality, cleanliness, and safety for everyone, which include the non-Muslim society [37].

Lastly is the perceived naturalness of the product. The naturalness of a product can be seen as better looks and taste by Western consumers [34].

H<sub>1</sub>: Price significantly affects the consumers’ acceptance towards entomophagy.

H<sub>2</sub>: Perceived benefit (Halalness) significantly affects the consumers’ acceptance towards entomophagy.

H<sub>3</sub>: Perceived Naturalness significantly affects the consumers’ acceptance towards entomophagy.

## *2.3. The impact of social trusts and norms on consumer acceptance towards entomophagy*

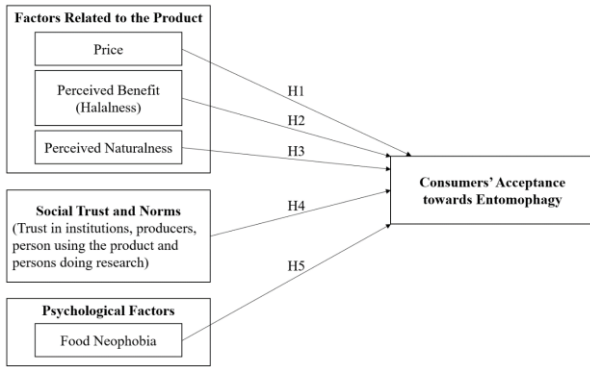
The second impact is trust. Consumers rely on trust to accept a product, because it makes them easier to make their-own decision [29]. The literature reviews show that social trust and norms include the trust in institutions and producers, in the person using the product, and in the person doing the research. Social trusts and norms are defined as an individual’s perception or judgment of the social pressure to perform or not to perform a target behavior [38]. In general, people will experience social pressure when they believe that they need to behave in a specific manner as required by relevant social referents [39] [40]. Such social pressure will motivate people to behave or carry out their actions which is perceived as important to others as explained in the Cognitive Dissonance Theory [41]. Similarly, social trust and norm is also being seen as a feeble predictor of intention in numerous reviews on food choice decisions [42] [43] [44]. In contrast, social trust and norms have a significant influence on green-food purchase behavior [45] [46] [47] [48].

H<sub>4</sub>: Social trust and norms significantly affects the consumers’ acceptance towards entomophagy.

## *2.4. The impact of psychological factors on consumer acceptance towards entomophagy*

Related to the third impact, consumer acceptance can also be influenced by psychological factor such as culture that can affect someone’s food preference, food choice, and food liking [28] [49]. Psychological factors consist of food neophobia. According to [50], food neophobia has a positive influence on consumers’ preferences towards ethnic food in restaurants. They found that food neophilic consumers have more positive attitudes towards ethnic food to try new flavors and cultures. On the other hand, respondents with a higher level of food neophobia consider origin to be an important attribute of ethnic food as compared to those who have lower food neophobia level.

H<sub>5</sub>: Food neophobia significantly affects the consumers’ acceptance towards entomophagy.



**Figure 1**  
Research Model

### 3. RESEARCH METHOD

#### 3.1. Population, Sample, and Sampling

In this study, the population is the consumers from Indonesia. The quantitative method was applied in this study. For quantitative measures, convenient sampling was chosen. The sample size taken is 100 respondents. Since there are 5 independent variables, the minimum sample size requirement necessary to achieve a statistical power of 80%, for detecting  $R^2$  of at least 0.25 (with a 5% probability of error) is 70 [51].

#### 3.2. Measurements

There is a total of 20 indicators for measuring all variables, namely 3 for Price, 3 for Perceived Benefits, 2 for Perceived Naturalness, 5 for Social Trusts and Norms, and 5 for Consumers' Acceptance toward Entomophagy [52]. All indicators use a 5-point Likert scale.

Besides, researchers also took the social demographics data including gender, area of origin, area of residence, tribe / ethnicity, urban / rural area, age, income, protein supplement, and lifestyle.

#### 3.3. Data Collection

The data gathered from the questionnaire included the opinions and purposes of eating insects and other uses, how they were used or cooked, some ecological information of the insects, and some background information of the respondents.

#### 3.4. Data Analysis

Data was analyzed using Partial Least Square-Structural Equation Modelling (PLS-SEM). PLS-SEM consists of outer-model and inner-model analysis. For the outer model / measurement model, we performed the validity and reliability test. The validity test will differ into convergent validity and discriminant validity. The measurement for convergent validity uses the Average Variance Extracted [53] [54]. The measurement for discriminant validity uses

the Heterotrait-Monotrait ratio [55]. The reliability test will differ into indicator reliability and internal-consistency reliability. The measurement for indicator reliability uses the standardized loading and p-value [56]. The measurement for internal consistency reliability uses composite reliability [57].

For the inner model / structural model, we evaluated the structural-model collinearity, size, significance of path coefficients, explained variance of endogenous variables, effect size, and predictive relevance. Multicollinearity is unlikely if the VIF values  $< 5$  [58]. The explained variance of endogenous variables is weak if  $R^2 > 0.25$ , medium if  $R^2 > 0.5$ , and strong if  $R^2 > 0.75$  [59]. The exogenous constructs significantly contribute to explaining the endogenous latent variable if p-value  $< 0.05$  [60]. Effect size is meaningless if  $f^2 < 0.02$ , weak if  $f^2 > 0.02$ , medium if  $f^2 > 0.15$ , and strong if  $f^2 > 0.35$  [59] [60]. The model has predictive relevance for a certain endogenous construct, if  $Q^2 > 0$  [57].

### 4. RESULTS AND DISCUSSION

#### 4.1. Respondent Characteristics

The total respondents are 100 people. The number of male and female respondents was balanced. Most of the respondents came from and live in The Jakarta Special Region. Almost all respondents are Indonesian Chinese and lived in urban areas. Most of the respondents were 19-22 years old. In term of income, almost all respondents were at the lowest income-level, which was below IDR 36,000,000 per year. This is understandable, because the majority of respondents were still students who have not worked yet. The number of respondents who consumed and did not consume protein-enhancing foods was balanced.

#### 4.2. Results

##### 4.2.1. Outer Model

##### 4.2.1.1. Convergent Validity and Discriminant Validity

All indicators and dimensions passed the convergent validity test with an average variance extracted value greater than 0.5 (**Table 1**).

All variables passed the discriminant validity test with HTMT-ratio below 0.9 (**Table 2**).

##### 4.2.1.2. Indicator Reliability and Internal Consistency Reliability

All constructs passed the indicator validity test due to the standardized-loading greater than 0.708 (**Table 2**). Three indicators (PRICE3, HALAL2, STN5) still can be accepted since it is still above 0.4 and the AVE of its construct is still greater than 0.5.

All indicators and dimensions passed the internal consistency reliability test with the composite reliability values greater than 0.7 (**Table 1**).

**Table 1** Assessment of Construct Reliability and Convergent Validity

Construct	Items	Loadings	p-value	AVE	CR
Price	PRICE1	0.834	0.000	0.596	0.814
	PRICE2	0.813	0.000		
	PRICE3	0.657	0.000		
Perceived Benefit (Halalness)	HALAL1	0.928	0.000	0.642	0.776
	HALAL2	0.650	0.006		
Social Trust and Norms	STN1	0.776	0.000	0.588	0.876
	STN2	0.829	0.000		
	STN3	0.855	0.000		
	STN4	0.757	0.000		
	STN5	0.590	0.000		
Perceived Naturalness	PN1	0.970	0.000	0.931	0.964
	PN2	0.961	0.000		
Food Neophobia	NEO1	0.832	0.000	0.658	0.852
	NEO2	0.839	0.000		
	NEO3	0.770	0.000		
Consumers' Acceptance towards Entomophagy	ACCP1	0.920	0.000	0.803	0.953
	ACCP2	0.905	0.000		
	ACCP3	0.910	0.000		
	ACCP4	0.928	0.000		
	ACCP5	0.813	0.000		

**Table 2** Discriminant Validity Using HTMT Criterion

	FN	PB	PN	P	STN	CAE
FN						
PB	0.523					
PN	0.701	0.149				
P	0.184	0.149	0.106			
STN	0.170	0.199	0.137	0.566		
CAE	0.370	0.389	0.292	0.695	0.395	

**Table 3** Lateral Collinearity Assessment for Structural Model

Construct	Consumers' Acceptance towards Entomophagy (VIF)
Price	1.237
Perceived benefit (Halalness)	1.134
Perceived Naturalness	1.566
Food Neophobia	1.701
Social Trust and Norms	1.258

**4.2.2. Inner Model**

**4.2.2.1. Multicollinearity**

There is no multicollinearity between price, perceived benefit (Halalness), perceived naturalness, food neophobia, social trust, and norms and consumer acceptance toward entomophagy, with VIF value below 5 (**Table 3**).

**4.2.2.2. Coefficient of Determination (CAE)**

The R<sup>2</sup> value of CAE is 0.523. It means that 52.3% of CAE variation can be explained by factors related to the product, social trust and norms, and psychological factors. This can be considered as a substantial model, because the value is above 0.26 as suggested by [61].

**4.2.2.3. Hypothesis Testing**

This study has developed 5 direct hypotheses. The significance level, t-statistics for all paths were generated using the bootstrapping function. **Table 4** shows the assessment of the structural model. The results show that only 4 direct hypotheses have t-values higher than 1.645, which are significant at 0.05 level. Specifically, the predictors of Price ( $\beta = 0.487, p < 0.01$ ) and Perceived Benefit (Halalness) ( $\beta = 0.319, p < 0.01$ ) are positively related to Consumers' Acceptance towards Entomophagy, while the predictors of Perceived Naturalness ( $\beta = -0.122, p < 0.05$ ) and Food Neophobia ( $\beta = -0.284, p < 0.01$ ) are negatively related to Consumers' Acceptance towards Entomophagy. Thus, H<sub>1</sub>, H<sub>2</sub>, H<sub>3</sub>, and H<sub>5</sub> were supported. However, in this study, H<sub>4</sub>: Social Trust ( $\beta = 0.082, p > 0.05$ ) towards Consumers' Acceptance towards Entomophagy was not supported.

**4.2.2.4. Effect Size ( $f^2$ )**

The effect size ( $f^2$ ) assesses the relative impact of a predictor construct on an endogenous construct. The values of 0.02, 0.15, and 0.35 indicate that it has small, medium, and large effects respectively [61]. **Table 4** shows that Price (0.402) has a large effect in producing the R<sup>2</sup> for Consumers' Acceptance towards Entomophagy, while Perceived Benefit (Halalness) (0.188) has a medium effect in

producing the R<sup>2</sup> for Consumers' Acceptance towards Entomophagy. In addition, Perceived Naturalness and Food Neophobia have a small effect in producing the R<sup>2</sup> for Consumers' Acceptance towards Entomophagy.

**4.2.2.5. Predictive Relevance ( $Q^2$ )**

The predictive relevance of the model is assessed by using the blindfolding procedure. **Table 4** shows that the Q<sup>2</sup> value for Consumers' Acceptance towards Entomophagy is 0.401, which is larger than 0. This indicates that the model has sufficient predictive relevance.

**4.2.2.6. Effect Size of  $q^2$**

Lastly, the effect size of  $q^2$  is used to assess the exogenous construct's contribution to an endogenous latent variable's Q<sup>2</sup> value. The  $q^2$  values of 0.02, 0.15, and 0.35 indicate that an exogenous construct has a small, medium, or large predictive relevance for a certain endogenous construct respectively [57]. **Table 4** shows that there is a medium  $q^2$  effect size for Price (0.250) on Consumers' Acceptance towards Entomophagy, while Perceived Benefit (Halalness) (0.112), Perceived Naturalness (0.008), and Food Neophobia (0.062) have small  $q^2$  effect size on Consumers' Acceptance towards Entomophagy.

**Table 4** The Results of Hypothesis Testings

Hypothesis	Std. Beta	Std. Error	t-Value	Decision	R <sup>2</sup>	f <sup>2</sup>	Q <sup>2</sup>	q <sup>2</sup>
H <sub>1</sub> : Price → Consumers' Acceptance towards Entomophagy	0.487	0.069	7.063**	Supported	0.523	0.402	0.401	0.250
H <sub>2</sub> : Perceived Benefit → Consumers' Acceptance towards Entomophagy	0.319	0.090	3.529**	Supported		0.188		0.112
H <sub>3</sub> : Perceived Naturalness → Consumers' Acceptance towards Entomophagy	-0.122	0.067	1.812*	Supported		0.020		0.008
H <sub>4</sub> : Social Trust and Norms → Consumers' Acceptance towards Entomophagy	0.082	0.064	1.283	Not Supported		-		-
H <sub>5</sub> : Food Neophobia → Consumers' Acceptance towards Entomophagy	-0.284	0.075	3.769**	Supported		0.100		0.062

Note: \*\*p<0.01, \*p<0.05

**4.3. Discussions**

All three factors (Price, Perceived Benefit / Halalness, and Perceived Naturalness) that are related to the product significantly affect the consumers' acceptance towards entomophagy. This research found that price has the largest effect size  $f^2$  and  $q^2$  compared to other factors. Besides, it was also strongly associated with the consumers' acceptance towards entomophagy. This shows that price is indeed an important factor that influences Indonesian consumers' acceptance towards entomophagy. A similar significant result was found with both Australian and Dutch

participants, in which both price and good quality of food are important to them [2]. It also confirmed the previous researches that reasonably-priced edible insects can attract the consumers' acceptance towards entomophagy [2] [29] [33].

Perceived benefit (Halalness) was found to be positively associated with consumers' acceptance towards entomophagy in this research. Indonesia is a country with the most Muslim populations, whereas Halal certification provides safety assurance such as cleanliness and quality to them. When Indonesian consumers perceived the benefits

received from the food, then they will likely accept consuming the edible insects. For example, Western Kenya consumers can accept edible insects as non-meat protein, when they perceived that the edible insects were beneficial to them [62]. This supported the work of [34] mentioning that when consumers are aware of the benefits of the product, it increases the chance of consumers' acceptance towards a new product.

Perceived Naturalness was found to be negatively associated with consumers' acceptance towards entomophagy. Indonesian consumers perceived that edible insects is natural food. Previous research also found that both Dutch and Australian consumers associate insects with natural food [2]. In other related fields, perceived naturalness influences consumer acceptance towards new production methods such as cultured-meat [63]. This might occur because consumer usually perceived that natural food usually looks better and taste better [29].

Furthermore, a type of psychological factor, namely food neophobia was also found to be negatively associated with consumers' acceptance towards entomophagy. This phenomenon indicates that Indonesian consumers were afraid of trying new novel-food such as edible insects. This might happen because the entomophagy-food product is still new in the market and they feel that insects are disgusting. Similarly, [64] found that Italian students of University of Naples Federico II were not willing to pay for insect-based products, especially towards unfamiliar food. Besides, both consumers from China and Germany also found that high scores for food neophobia led to a lower willingness to eat unprocessed insects, because eating insects was considered as an unfamiliar and uncommon food practice [65].

Lastly, social trusts and norms surprisingly do not significantly affect consumers' acceptance towards entomophagy. Previous literature has found that social trust is significant towards consumers' acceptance towards entomophagy [2] [62]. However, this research found that social trusts and norms are not important to Indonesian consumers. This might happen because the edible insects are considered as a new food to them and they are still skeptical on trusting any sources that promote edible insects.

The acceptance of edible insects must be supported by education and awareness by highlighting the multifunctionality of biodiversity-friendly agricultural practice which involve a closer collaboration with farmers, rural communities and the management of complex system; human diet and health; and ecosystem function. To change the agricultural production or consumption practices, education and awareness from all actors involved in the production, marketing, and consumption of agricultural products such as edible insect that play an important role in the transformation process. For example, there is an intentional movement which link the producers, marketers, and consumers who value food quality, benefits, naturalness, and environment, who pursue alternative

approaches to production and consumption of sustainable agricultural products. By managing and practicing good manufacturing practices (GMP) and good agricultural practices (GAP), the producers are able to follow the standard operating procedure (SOP) to process the edible insects in order to produce the best quality edible insects by preserving its natural nutrients. To gain trust and confidence from the consumers, marketers need to display the Halal logo which represents the symbol of hygiene, quality, and safety in food product. There is also an increasing number of non-profit organizations and consumer groups, who are active in the area of food politics developing radical critiques of current narrowly-based agricultural production systems [65]. When considering the linkage and trade-offs between agricultural, environmental and social policies, the promotional approaches practiced by marketers need to reflect the overall ecosystem perspective and socio-ecological consideration [65] in order to increase the consumers' acceptance towards edible insects.

## 5. CLOSING

### 5.1. Conclusions

1. Factors that are related to the product (Price, Perceived Benefits / Halalness and Perceived Naturalness) affect the consumers' acceptance towards entomophagy.
2. Social trusts and norms do not affect the consumers' acceptance towards entomophagy.
3. Psychological factors (Food Neophobia) affects the consumers' acceptance towards entomophagy.

### 5.2. Limitations and Suggestions

#### 5.2.1. Limitations

This research has several limitations such as:

1. This study was using convenience-sampling method. Therefore, the results cannot be generalized to a more diverse and larger population.
2. Several dimensions of variables failed the validity and reliability tests. This may be because the translation of English-version of the questionnaire into the Indonesian-version does not have the same meaning and understanding among different respondents in different countries.

#### 5.2.2. Suggestions

1. Future studies should use larger samples with a probability-sampling technique.
2. Future studies are recommended to use a variable of measurement that contains more indicators.

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