

A Comparison of Attitudes towards Entomophagy

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Abstract



Figure 1: Kaiko-Hasshu. A delicacy in Japan made of ground silkworms, onion, cilantro, and garlic.¹

With an estimated world population of nine billion people by 2050, global food production will have to double. Insects are a viable way to fill this need but most Western societies' view of entomophagy, the practice of eating insects, is with disgust. Whereas, other cultures from around the world eat insects regularly to meet their nutritional needs. In this study, a portion of the undergraduate body at the University of Minnesota Duluth was assessed for their perspective of entomophagy. The results indicated that there is a gender difference between females and males, where males are more willing to engage in entomophagy than females. In addition, there is not a significant difference on the perspective of entomophagy based on academic major, nor due to the perceived experience of an individual's first recalled encounter with an insect. The results of this study can be used to design specific tactics for educating current generations in Western societies of the custom of entomophagy.

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Introduction

With an estimated world population of nine billion humans by the year 2050, global food production will have to double to prevent mass starvation.² In addition, with developing countries adapting a more resource intensive Westernized diet, the problems the world is currently facing, e.g. water shortages, land management, and sustainable production, will be compounded.^{3,4} Alternative sources of nutrition, such as insects, are available to meet the needs of a global society, but how open are Western societies to the idea of eating insects? Insects have been a source of nutrition for humans since our nomadic ancestors first wandered the Earth. Even today, insects are a regular part of people's diets in Africa, Asia, and Latin America. However, in many Western cultures, e.g. the United States and Western Europe, most people view entomophagy (the practice of eating insects, especially by people) with disgust.

The World Health Organization (WHO) proposed a theory on the origin of the Western perspective of entomophagy, which may have begun when our nomadic ancestors settled into colder climates that later became Western societies. Cold climates do not support the variety of insects found in tropical climates, causing human-insect interactions to become more rare. Consequently, when humans do encounter an insect, neophobia (fear of new things) may cause humans to avoid them, which would lead to insects falling out of the Western diet.⁵ Humans are evolutionarily predisposed to be cautious around something new since ancestral *Homo sapiens* who tried new things often had a higher probability of being killed.⁶ However, when neophobia is applied to food it appears that genetics have only a slight influence and psychosocial factors are the major influence.⁷⁻⁹ Young children carefully watch their parents and observe their food preferences, and this may produce neophobic tendencies with regard to eating if parents tend to avoid certain foods.^{8,9}

Another theory about the origin of this aversion to insects concerns the agricultural issues caused by locusts throughout history.¹⁰ The repercussions from plagues of locusts can cause deep-rooted fears against certain species of insects and over time develop into a general aversion to the entire class of insects, entomophobia.^{3,11} The symptoms of entomophobia are similar to those of other irrational fears. When a human with entomophobia encounters an insect they can experience a full-blown series of panic attacks.¹² Therefore, bad encounters with insects in the past or a general neophobia may have initiated a dislike towards insects; however, these theories do not explain why current societies in the world have an extremely positive stance of entomophagy while others do not.

Researchers have documented in numerous countries the practice of entomophagy, ranging from Asian-Pacific to Latin American cultures.¹³⁻¹⁶ Entomophagy represents a significant source of protein for many ethnic groups' diet. People in Japan, Thailand, and Vietnam raise crickets in sheds in their backyards and the techniques they use have been refined over numerous generations.⁵ In some areas, like northeastern Thailand, the practice of eating insects is an important aspect of their culture and the tradition has spread into southern Thailand.^{13,14} Therefore, the children being raised in these cultures are being exposed and are eating insects regularly at an early age, which leads to entomophagy being a normal part of their cultural diet.

Insects are also highly regarded as a food delicacy in these cultures and consequently are highly valued and expensive. In India, the pupa of the eri silkworm "is more or less a byproduct." In other words, the people of India would rather spend their time and energy collecting the silkworms to sell or eat than collecting the silk cocoon for clothing. Throughout the market squares of Mexico City frozen chicatanas, giant winged ants used in salsa, sell for about \$225 a pound; in comparison, armadillo steaks cost \$72 per pound in southern Texas.^{15,16} Therefore, insects may be even more of a delicacy in the world than an expensive meal in Western countries.

The practice of entomophagy is not limited to a few parts of the world but is found all over the globe in non-Western societies. (Figure 2)¹⁷ In addition, insects are found in a great variety, just in the Democratic Republic of Congo there are more than 300 species of insects in at least 22 different taxonomic families that are reported as food, e.g. mealworms (*Tenebrio molitor*), house crickets (*Acheta domesticus*), grasshoppers (*Ruspolia differens*), termites of the species *Macrotermes* and *Syntermes*, the mopane caterpillar (*Imbrasia belina*), and the silkworm *Bombyx mori*.^{3,17} Overall, there is no shortage in the variety of edible insects, nor where entomophagy is practiced throughout the world. If entomophagy is to be a part of the solution to feeding a rapidly-expanding population, Western societies need to learn about the benefits of entomophagy and change their cultural attitudes.

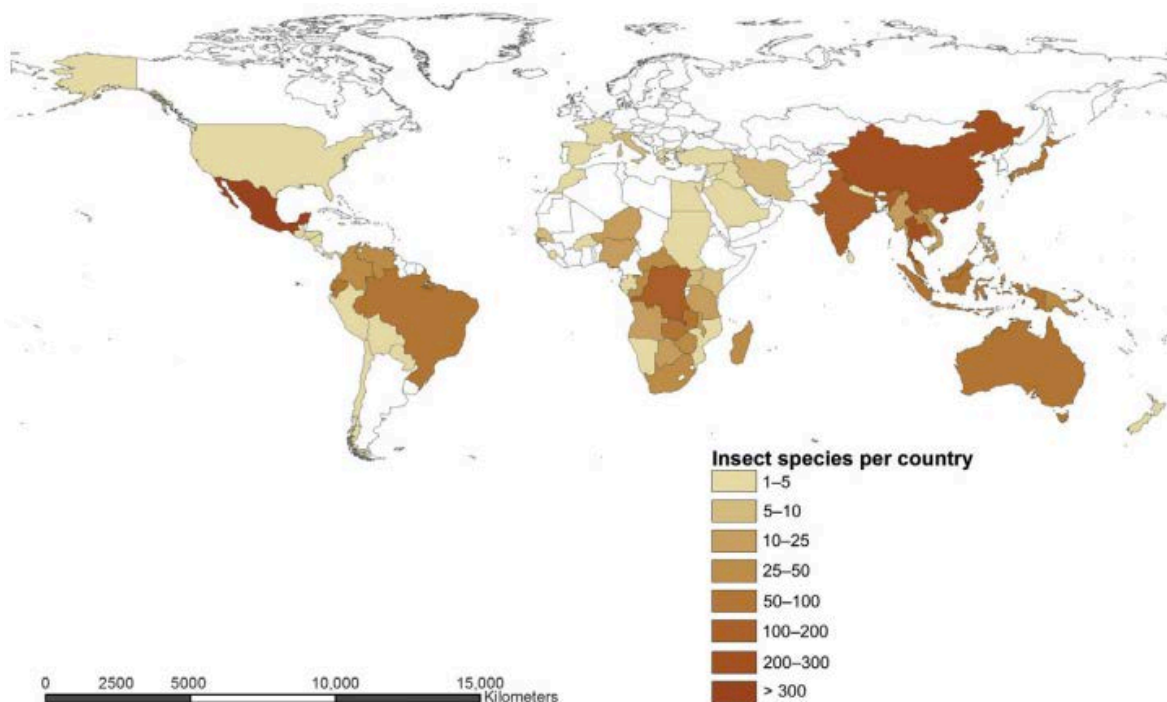


Figure 2: Recorded edible insect species in the world.¹⁷

Research published last year shows that when individuals from a Western society have a pleasant experience with entomophagy, they were more willing to use insects as a source of nutrition and an ingredient in cooking and baking, regularly, if available at supermarkets and street markets.¹⁸ However, at the beginning of the survey, as the researchers expected, there was some neophobia about the idea of entomophagy. The participant's neophobia was mitigated by their participation in the survey. A contradictory finding obtained during the administration of different insect meals was the willingness of participants older than 45 to try new foods, which the researchers hypothesized was due to the participants increased knowledge and familiarity about entomophagy. The 189 Belgian participants, who tried numerous types of insect cooked, boiled, and/or flavored reported that they prefer insects that were baked and had a crispy texture. In addition, the participants thought the mealworms were a tasty treat with vanilla flavoring or covered in chocolate.¹⁸ Although this article only tested the Belgian populace, it is a good indication that Western cultures are willing to accept new sources of nutrition.

A study similar to the Belgium one was published this January that explored the different perceptions and expectations regarding entomophagy in two different cultural contexts – one where entomophagy is regularly practiced (Thailand), and one where entomophagy is not (The Netherlands).^{14,19} Within each culture, groups of people that differed in levels of eating experience were selected. Through structured discussions about insects as food and images of various species and insect-based products, the effects of cultural exposure and

individual experiences on consumer perceptions were examined. The data obtained indicated that the culture an individual is exposed to while growing-up causes one to create expectations of future experiences, e.g. which species of insects were more appropriate to eat and how they should be prepared, whereas individual experiences determined whether judgments were made based on memories of past eating experiences or based on the visual properties and item associations. This study provides insights into the acceptance and rejection factors of unfamiliar food items and identifies the factors to be considered when introducing novel food items that are not yet culturally acceptable.^{14,19}

Overall, the previous research performed on the topic of entomophagy indicates that non-Western societies engage in entomophagy because it is a part of their culture and has been for many generations. They are raised eating insects and even grow them themselves. In addition, some types of insects are delicacies and are even more expensive than an expensive steak. In contrast, Western societies are apprehensive towards entomophagy due to being unfamiliar with the practice and having expectations that insects are not enjoyable to eat, but when they have a good experience with entomophagy they are more willing to engage with the practice. However, the challenge lies in the specific tactics used in revealing and educating current generations in Western societies of the custom of entomophagy.

The cultural adaptability of entomophagy in Western societies needs to be assessed because if entomophagy is going to become a viable source of nutrition the cultural attitude of Western societies will need to change. This study assesses the openness of undergraduate students at the University of Minnesota Duluth (UMD) to the idea of entomophagy. UMD was chosen is due to the location (Duluth, Minnesota, USA) and logistics of conducting the study.

Methods

The data for this research project was acquired using a self-developed survey with questions adapted from previous research.^{14,18,20} These questions assessed the respondents' outlook of entomophagy, first encounter with insects, collegiate affiliation at UMD, and their gender (see Appendix). The survey was distributed to two large classes in the Fall of 2014, BIOL 1011: General Biology 1 and BIOL 1001: Biology and Society, these classes were chosen due to simplicity in logistics for approval of distribution of the survey and the variety of students that would be voluntarily participating. BIOL 1011 is normally enrolled with students who are core science majors, e.g. biochemistry, biology, engineering, etc.; whereas, BIOL 1001 students are from all other majors at UMD, e.g. music, sociology, business, etc.

Results

A total of 96 responses were collected between the two classes. Of the 96 respondents 59% were female and 41% were male. Males as a group of respondents were more likely to engage in entomophagy on a regular basis, 41%, and females were more likely to never practice entomophagy, 33%. However, more females stated that they were open to learn about the health and sustainability benefits of entomophagy than males, 29% vs. 23%. (Figure 3) The mean of the female and male responses was 3.25 and 2.33, respectively, and their respective standard deviations are 1.47 and 1.38. A t-test was performed and the resulting p-value was 0.00265.

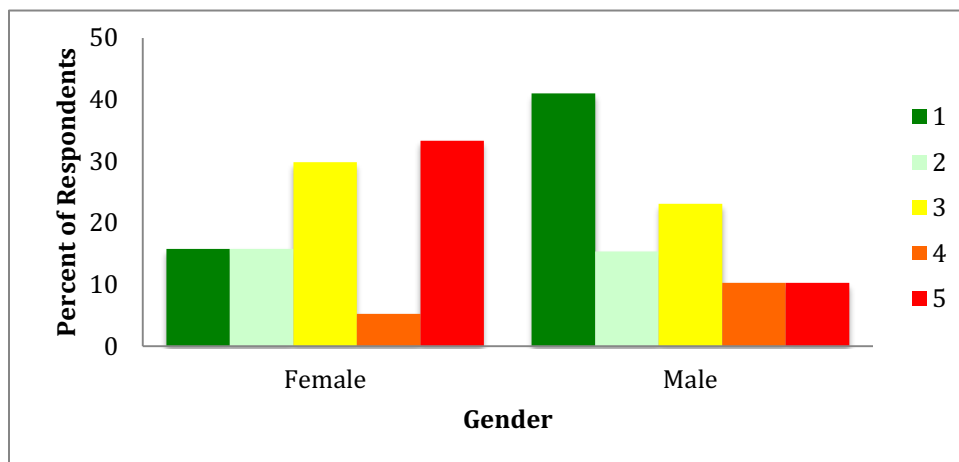


Figure 3: Preferences towards entomophagy divided by gender. From a scale from 1 to 5, with 1 being that they would actively eat insects if they were available in my area, 2 being that they would eat insects if they didn't look like an insect and were flavored, 3 needing information about the benefits of entomophagy as compared to beef, chicken, and pork, 4 if someone would dare them, and 5 being that they would never eat an insect.

There are five undergraduate colleges within the University of Minnesota Duluth, the College of Education and Human Service Professions (CEHSP), College of Liberal Arts (CLA), Labovitz School of Business and Economics (LSBE), Swenson College of Science and Engineering (SCSE), and the School of Fine Arts (SFA). Of the 96 respondents 19% were from CEHSP, 15% CLA, 15% LSBE, 46% SCSE, and 5% SFA. All colleges have a pretty even distribution except for SFA, which has a 60% of SFA respondents never wanting practice entomophagy, whereas other colleges are below 30% for 5. SCSE had the highest percentage of 31% and CLA and LSBE tied for the lowest with 21% engaging in entomophagy on a regular basis. However, CLA was the most open to learning about entomophagy than any other college with 36%. (Figure 4) An analysis of variance (ANOVA) single factor test was performed on this data and the resulting p-value was 0.140.

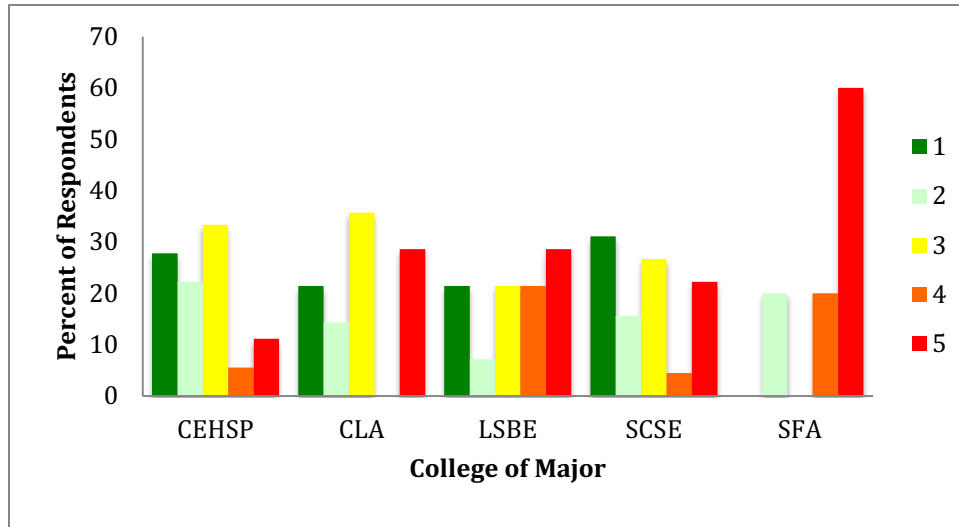


Figure 4: Undergraduate colleges at UMD and their respective preferences towards entomophagy. From a scale from 1 to 5, with 1 being most favorable and 5 being the least favorable towards entomophagy. No data is available for preferences number 4 for CLA and numbers 1 and 3 for SFA.

Of the 96 respondents 30% reported remembering a good 1st encounter with insects, 28% had an ok 1st encounter, and 42% had a bad encounter. Of the respondents who had a good 1st experience with insects 32% also stated they would engage in entomophagy regularly and the respondents who had a bad 1st experience, 24% would also practice entomophagy. There is a trend in the percent of respondents who would never practice entomophagy, the lowest percentage of 7 % in the respondents who had a good 1st experience increasing to 31% in the bad 1st encounter. (Figure 5) ANOVA: single factor test was performed on this data and the resulting p-value was 0.121.

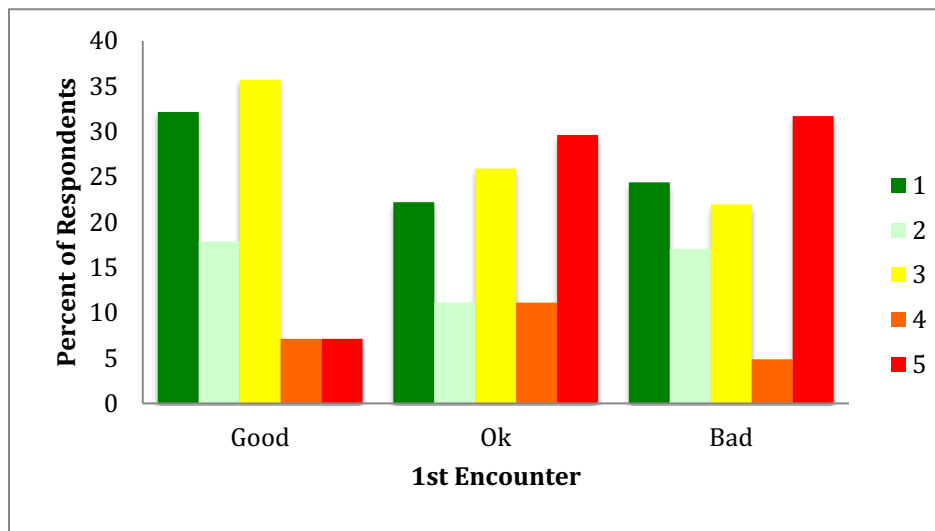


Figure 5: The 1st encounter that respondents can remember that they had with insects. From a scale from 1 to 5, with 1 being most favorable and 5 being the least favorable towards entomophagy.

Discussion

Gender was assessed as a curiosity, to see if the typical stereotype of men being more adventurous than women was statistical.²⁰ From the results obtained from this survey it appears there is a significant difference, due to the p-value being less than 0.05, between the female and male responses. Males at the UMD are more willing to regularly eat insects than women. A possible explanation for this difference is societal and cultural influences. Females are stereotyped as being more afraid of insects and males are stereotyped as being stronger. In addition, in the responses to the survey, whenever some called for someone to come and kill an insect in their vicinity they almost always called for a male figure. However, the female respondents are more willing to learn about the benefits of entomophagy, possibly indicating they are more open to the idea of it and just need be explained the benefits.

The theory behind testing the collegiate categories at UMD was to test whether science majors, with their implied orientation to the scientific method, were more willing to engage in entomophagy.²¹ This orientation might allow SCSE majors to think more logically about the benefits of entomophagy and be less likely to exhibit the cultural disgust of eating insects. However, there is no statistical data supporting this hypothesis, p-value greater than 0.05; therefore, the difference between the SCSE majors being more positive towards entomophagy than SFA majors is due to random chance in this study. This finding of a lack of difference in attitudes toward entomophagy between those pursuing different types of academic majors implies that the approach to teaching people about the benefits of entomophagy can be more generalized.

As stated previously, one hypothesis for opposition to entomophagy was bad experiences with insects in the past.^{3,14} However, the data collected on this topic would indicate otherwise, at least in the context of recalled first encounter with an insect by the respondents. The findings are not statistically significant, p-value greater than 0.05, although there is a general trend towards respondents who had a good initial recalled encounter with insects being more inclined to engaging in entomophagy and vice versa. (Figure 5) This result is encouraging with regard to changing attitudes about entomophagy, as it would seem to indicate that a person's bad initial encounter with an insect does not preclude a favorable attitude toward entomophagy.

Although, there are some fractions of society that will take longer to warm up to the idea of eating insects, farmers' aversion to raising insects, due to histories of infestations from grasshoppers and locusts, is likely to be even stronger. However, the techniques that prevent grasshoppers and crickets from escaping and reaping havoc while being raised have been refined from numerous years of cultivations.⁵ In addition, the broader public in urban areas may still be disturbed by the idea of eating insects, but the reality is that the

majority of people in Western countries have already consumed insects in numerous food products. For example, according to the United States Food and Drug Administration's booklet, Food Defect Action Levels, average contamination levels below 150 insect fragments per 100 g of wheat flour pose no health danger. Other examples of the maximum permissible levels of insect contamination in human food products are listed in Table 4.²³ Furthermore, insect "impurities" may be good for a person's health.²²⁻²⁶ For example, people who eat rice regularly typically ingest a significant number of rice weevil larvae, and this has been suggested as an important source of vitamins.

Table 4: Maximum permissible levels of insect contamination in food products²³

Product	Type of insect contaminant	Maximum permissible level
Canned sweet corn	Insect larvae (corn ear worms or corn borers)	Two or more 3 mm or longer larvae, cast skins, larval or cast skin fragments, the aggregate length of insects or insect parts exceeds 12 mm in 24 pounds
Canned citrus fruit juices	Insects and insect eggs	Five or more <i>Drosophila</i> and other fly eggs per 250 ml or 1 or more maggots per 250 ml
Frozen broccoli	Insects and mites	Average of 60 or more aphids and/or thrips and/or mites per 100 grams
Hops	Insects	Average of more than 2 500 aphids per 10 grams
Ground thyme	Insect filth*	Average of 925 or more insect fragments per 10 grams
Ground nutmeg	Insect filth*	Average of 100 or more insect fragments per 10 grams

Note: * Filth referees to anything smaller than 0.1 millimeters (e.g. insect hair, cell, and fragments).

However, possibly the largest barrier to entomophagy becoming a more important food source, not rooted in psychology and culture, is the price of insects. Currently, a pound of dried crickets costs \$27.15 (which is about 7.5 cups), a pound of ground beef cost \$3.99 (for only 2 cups).²⁷ Although the cost is significantly higher, about 6.8 times more, the price will come down when insects are in mass production for human consumption, which would make it an easier choice for consumers. Additionally, the percentage of an insect that is edible is far higher than other animals; for example, 80% of a cricket is edible, whereas only 55% of a pig or a chicken and only 40% of a cow is edible.⁵ Therefore, a consumer will be getting a better value by buying an equivalent amount of whole insect per pound.

The barriers to entomophagy in Western societies are based on misplaced perceptions and attitudes that defy logic. Insects are a healthy alternative to common Western meat products as they contain more protein, vitamins, and minerals. Taste should not be a barrier to the consumption of insects, and there is not evidence that consuming insects designated for human consumption causes disease. When insects are grown in mass production, the price is likely to be on a competitive level with current Western meat products. When the topic of entomophagy is thought about logically, the benefits become clear and the opposition will fall to the wayside.

Conclusion

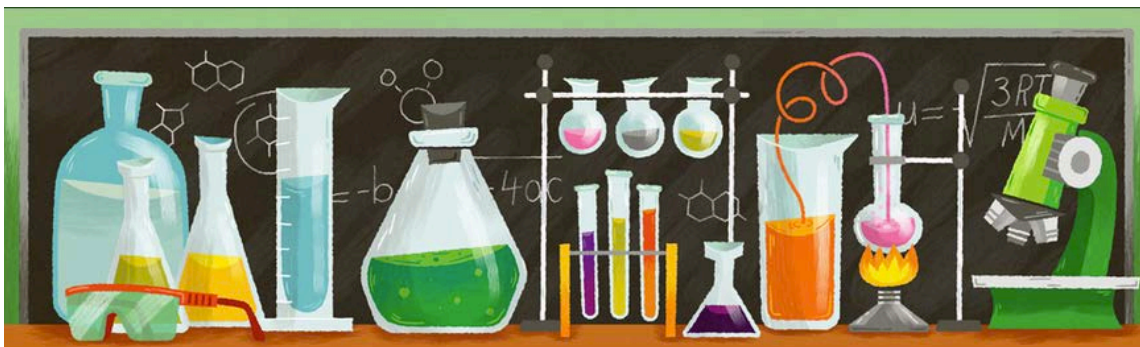
Entomophagy is not a novel idea, but is actually an important part of many peoples' diets in many parts of the world (e.g. Democratic Republic of Congo, India, and Mexico, to name a few). In addition, growing insects, as another nutritional source for human consumption would help alleviate the problems associated with an ever-increasing global population. From this study at the University of Minnesota Duluth established that there is a difference in viewpoints on entomophagy by gender, males are more willing to practice entomophagy regularly than females. However, there is not a significant difference on the perspective of entomophagy based on academic major, nor based on the experience of an individual's first recalled encounter with an insect. This helps to guide the approaches to teaching the general population about the benefits of entomophagy and implies they will not need to be greatly tailored to different sectors of society. We as a Western society need to rise above our cultural disgust of insects and think logically about the facts presented and act accordingly. Therefore, if you would like to get your fix of insects right now, you may go online to WorldEnto.com²⁸ where there are whole insects available, as well as, mixes, such as Chocolate Chirp Instant Cookie, Pancake, and Brownie Mix for those who are not ready for the whole deal.

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Appendix



Entomophagy

the practice of eating insects, especially by people

Please indicate your gender

☐ Female

☐ Male

☐ Other:

Please indicate your age

☐ >15

☐ 16-17

☐ 18-19

☐ 20-22

☐ 23-24

☐ 25+

Please indicate where you were born

City, State or Province, Country

Where did you spend most of your time growing up

City, State or Province, Country

What is your major?

If undecided indicate what you are leaning towards.

When you hear the word insect, what do you imagine?

Write about the type of insect, its size, and your feelings toward it.

Write about your first experience with an insect(s) that you can remember.

Try to mention your age and any parental or other influences that were around you at that time.

The term insect will refer to crickets, mealworms, grasshopper, termites, and caterpillars in the rest of the survey.

Will you be able to keep this in mind during the rest of the survey?

- ☐ Yes
☐ No

In the following situations which can you remain calm, cool, and collected? I.e. you can think logically about the situation and not panic.

Please choose all that apply. Remember insects refer to crickets, mealworms, grasshopper, termites, and caterpillars.

- ☐ Being outside and seeing a live insect in the grass.
☐ Being outside and seeing a dead insect in the grass.
☐ Being in a hall and seeing one walking across the floor.
☐ Holding a dead insect in your hand.
☐ Having a live insect on your arm
☐ Finding a dead insect in your cereal.
☐ Seeing an insect on an munching on your apple.
☐ Chewing a live insect.
☐ Eating a cooked insect.
☐ I can't deal with crickets, mealworms, grasshopper, termites, and caterpillars in any situation.

Which of the following statements describe you and your food preferences the best?

Please select one.

- ☐ I am constantly sampling new and different foods.
- ☐ I will eat almost anything.
- ☐ At dinner parties or when I go out to a new restaurant, I will try a new food.
- ☐ I am afraid to eat things I have never had before.
- ☐ If I don't know what is in a food, I won't try it.
- ☐ I don't trust new foods.

Are you a vegetarian or vegan?

If yes, please indicate whether you would consider eating an insect, in the "Other" box.

- ☐ Yes, Vegetarian
- ☐ Yes, Vegan
- ☐ No
- ☐ Other:

Do you associate any of the following statements with insects?

Please choose all that apply. Remember insects being: crickets, mealworms, grasshopper, termites, and caterpillars.

- ☐ Something our nomadic ancestors ate.
- ☐ A good source of high-value proteins.
- ☐ Are a delicacy in many parts of the world.
- ☐ More sustainable than classical meat products (e.g. chicken, pork, & beef).
- ☐ Insects require little space and resources to grow.
- ☐ Other:

Have you heard of people eating insects?

- ☐ Yes, I have heard of the eating of insects and know the benefits.
- ☐ I have heard of the eating of insects but actually don't know much about it.
- ☐ No, I have never heard of the eating of insects before this survey.
- ☐ Other:

What would it take for you to eat insects regularly?

Please choose all that apply. Regularly means 2-3 times per week.

- ☐ Nothing, I regularly eat them in all types of cuisine.
- ☐ I would eat them if they were affordable (e.g. a pound of grasshoppers cost the same as a pound of beef).
- ☐ I would eat them if they were available in my area (e.g. I could go to the DC and eat a cricket burger).
- ☐ Someone to inform me of the benefits of eating insects as compared to beef, chicken, and pork.
- ☐ If they didn't look like an insect and were flavored.
- ☐ If someone gave me something for it (e.g. money, bragging rights, etc.)..
- ☐ I would never eat an insect.
- ☐ I would eat them if they were affordable and available.
- ☐ Other:

Why wouldn't you eat insects?

Please choose all that apply. Remember insects refers to crickets, mealworms, grasshopper, termites, and caterpillars.

- ☐ I would eat normal insects like crickets, mealworms, grasshopper, termites, and caterpillars, but not scary and gross ones like spiders and cockroaches
- ☐ They are not clean. As in they contain lots of bacteria.
- ☐ When they are raw, they are too squishy.
- ☐ Because they taste bad.
- ☐ Other:

Is it acceptable to feed cows, pigs, and chicken insect feed instead of corn feed?

Acceptable as in that the animals won't mind the switch in food. Insect feed provides all the same nutrients as corn feed.

- ☐ Yes
- ☐ No
- ☐ Other:

Would it be a beneficial to feed cows, pigs, and chicken insect feed instead of corn feed?

Beneficial as in that the world will be better off by using an less intensive feed product.

- ☐ Yes
- ☐ No

Do you think insects will become a regular source of protein for ANIMALS within the United States in the next 20 years?

Regular meaning something that will be consumed 2-3 times per week.

- ☐ Yes
- ☐ Maybe
- ☐ No
- ☐ Other:

Do you think insects will become a regular source of protein for HUMANS within the United States in the next 20 years?

Regular meaning something that will be consumed 2-3 times per week.

- ☐ Yes
- ☐ Maybe
- ☐ No
- ☐ Other:

Is there any other reason or feeling that you were not able to express in the previous questions or survey?

Explain in the following box.

Thank you for your time!

- ☐ Hooray! You made it!!!
- ☐ Enjoy your Thanksgiving break!!!

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