

Introduction to “Entomophagy” Lab

Introduction

Can insects be considered as being edible and a good source of carbohydrates (lipids and protein)? Edible insects; you may feel that these two words do not even belong in the same sentence. You have every right to be skeptical. In all probability, you have never deliberately eaten an insect. However you have probably inadvertently consumed over a pound of insects in your lifetime. There is a term for this. The word is Entomophagy (en-ta-ma-f-a-gy) or bug eating.

Some insects are edible. In fact, most insects are edible, but there are a few species that are especially palatable, nutritious, and easily obtainable. Many species of insects are lower in fat, higher in protein, and have a better feed to meat ratio than beef, lamb, pork, or chicken. Insects are tasty. Even if you are too squeamish to have them as a main dish, you can make insect flour and add it to bread and other dishes for an added protein boost. Insects and some crustaceans contain a primary source of carbohydrates (polysaccharide) called “chitin” that makes up their exoskeleton or outer shell.

There are 1,462 recorded species of edible insects:

100 grams of cricket contains: 121 calories, 12.9 grams of protein, 5.5 g. of fat, 5.1 g. of carbohydrates, 75.8 mg. calcium, 185.3 mg. of phosphorous, 9.5 mg. of iron, 0.36 mg. of thiamin, 1.09 mg. of riboflavin, and 3.10 mg. of niacin.

Compare this with ground beef, which, although it contains more protein (23.5 g.), also has 288.2 calories and a whopping 21.2 grams of fat!

Insects are commonly found in the following foods:

Apple butter - 5 insects per 100g

Berries - 4 larvae per 500g OR 10 whole insects per 500g

Ground paprika - 75 insect fragments per 25g

Chocolate - 80 microscopic insect fragments per 100g

Canned sweet corn - 2.3mm-length larvae, cast skins or fragments

Cornmeal - 1 insect per 50g

Canned mushrooms - 20 maggots per 100g

Peanut butter - 60 fragments per 100g (136 per lb)

Tomato paste, pizza, and other sauces - 30 eggs per 100g OR 2 maggots per 100g

Wheat flour - 75 insect fragments per 50g

Your insect consumption adds up. Flour beetles, weevils, and other insect pests that infest granaries are milled along with the grain, finally ending up as tiny black specks in your piece of bread. Small grubs and other tiny insects can be found in your fruit and vegetables. Insects are especially common in canned and other types of processed food, and even in certain beverages, like apple cider for instance. They process the fallen and or rotten apples including the worms and insects who have found the apples on the ground. It is virtually impossible that you have not ingested insects in one form or another during your lifetime. And it probably did not harm you, but instead did you some good by providing extra carbohydrates and protein in your meal! If insects are prepared and cooked properly, then the insects can be considered edible and nutritious.



Procedure:

Apparatus:

Provide by School

Insects: varies (crickets, mealworms, superworms, scorpions, cockroaches, centipedes, etc...)

Most Kitchen Appliances and Utensils

* Some recipe items (need to verify)

Provided by Student

* See recipe (minus the insects and some recipe items (need to verify))

Steps:

1. Each group is to choose a recipe of their choice.
2. By using kitchen appliances and utensils, create the dish.
3. Note that the insects need to be prepared correctly.
4. Dish must be displayed in a gourmet manner.
5. A participation grade will be established based on professionalism and cleanliness.
6. Students are not required to try their or anyone else's dish.

Preparation

Those who are accustomed to eating animals probably know that most animals must be killed, cleaned, and cooked before one can eat them. The case is similar with insects. Although people in many other countries prefer to eat live insects as you will read below, it is always good for a beginner to start with dead insects.

If items have not been prepared for consumption prior to the activity, do the following:

If alive, purge their systems with bread and fruits for a couple days. Place them in a freezer in order to kill the animals.

Take the desired quantity of live insects, rinse them off and then pat them dry. This procedure is easy to do with worms and centipedes, but fairly hard to do with crickets/hoppers/roaches/scorpions/etc. To do so with crickets/hoppers/roaches/scorpions, pour them all into a colander and cover it quickly with a piece of wire screening or cheesecloth. Rinse them, and then dry them by shaking the colander until all the water drains. You don't really have to clean worms/centipedes, though if you want, you can chop off their heads or ends. Hoppers/roaches/scorpions heads, hind legs, and wing cases can be removed according to personal preference.

Recipes

Stir Fried Insects

vegetable oil

1 tablespoon of salt

1 tablespoon of corn starch

1 small onion

1 red pepper

1 green pepper

1 can of sliced water chestnuts

1 can of pineapple chunks

1 bag of white rice

candy thermometer (*take temperature of oil*)

Wok (optional)

a desired amount of insects (ie. hoppers, mealworms, centipedes, various bugs); note: scorpions if available.



Steps:

1. Remove and discard the solid wing covering flaps, all legs, head, and/or stinger of each animal.
2. Begin making the rice separately according to directions on bag. (basically 1 cup of rice in 2 cups of boiling water – simmer for about 7-8 minutes)
3. Prepare the oil by placing ~ 1/4 of an inch of oil on the bottom of a deep sauce pan and heating the oil to ~ 260 F
4. “Carefully” put a whole animal into a pot of heated oil and quickly fry for 60 seconds. Remove animal and place on plate with a paper towel. Repeat.
5. Add 4 tablespoons of oil into a deep sauce pan or wok and heat.
6. Add salt and corn starch for about 5 minutes
7. Put all vegetables and fruit into it to stir fry for 5 minutes.
8. Place the animals, vegetables and fruits onto a bed of white rice.

Chocolate Covered Insects

3-4 packages of semisweet chocolate squares
wax paper
a desired amount of insects (ie. hoppers, mealworms, centipedes, various bugs)



Bake insects at 325 F until crunchy (the time needed varies from oven to oven). Heat the squares of semi sweet chocolate in a double boiler (not sure ask how to do this) until melted. Dip the dry roasted animals in the melted chocolate one by one, and then set the chocolate covered animals out to dry on a piece of wax paper.

Insect Fried Rice

1 egg, beaten
1 teaspoon of vegetable oil
3/4 cup water
1/4 cup chopped onions
4 teaspoons of soy sauce
1/8 teaspoons of garlic powder
1 cup of rice
a desired amount of insects (ie. hoppers, mealworms, centipedes, various bugs)



Scramble egg in a saucepan, stirring to break egg into pieces. Add water, soy sauce, garlic, onions and animals. Bring to a boil. Stir in rice. Cover; remove from heat and let stand five minutes. Note: Don't cook rice separately.

Chocolate Chip Insect Cookies

2-1/4 cups flour
1 teaspoon of baking soda
1 teaspoon of salt
1 cup butter, softened
3/4 cup white granulated sugar
3/4 cup brown sugar
1 teaspoon of vanilla
2 eggs
1 12 oz bag chocolate chips
1 cup chopped nuts
a desired amount of insects (ie. hoppers, mealworms, centipedes, various bugs)



Preheat oven to 375 degrees. In a small bowl, combine flour, baking soda, and salt; set aside. In large bowl, combine butter, granulated sugar, brown sugar, and vanilla; beat until creamy. Beat in eggs. Gradually add flour mixture and insects; mix well. Stir in chocolate chips. Drop by rounded measuring teaspoonfuls onto un-greased cookie sheet. Bake for 8-10 minutes.

Insect Crunch

1/2 cup butter
1/8 cup honey
plain (no butter or salt) popcorn (pre-made suggested)
a desired amount of insects (ie. hoppers, mealworms, centipedes, various bugs)



Slowly heat butter and honey and mix well. Mix the insects with the popcorn and pour in the butter/honey mixture and stir well. Spread this out on a cookie sheet and bake at 350 degrees for 10 minutes. Arrange to your desire and serve.

Sautéed Insects

1/3 cup butter
1/4 teaspoon of garlic powder
a desired amount of insects (ie. hoppers, mealworms, centipedes, various bugs)



Melt butter, add garlic and sauté for several minutes to blend flavors and then add insects. Sauté for an additional 10 minutes or until tender.

Insect Patties

1 egg
1 small onion
salt and pepper (hot chili: optional)
bread crumbs
a desired amount of insects (ie. hoppers, mealworms, centipedes, various bugs)



Finely chop a cup of insects in a food processor (a blender would be difficult) with an egg, half a small onion, season with salt, pepper or even hot chili and enough bread crumbs to form dough. Mold the dough into patties and grille or pan fry until brown

Other: Verify with instructor

Investigate on your own for a recipe based on available insects and kitchen resources.



General Information: HOW TO USE INSECTS AS FOOD

Insects are being eaten in most of the world. Archaeological evidence tells us that entomophagy has been practiced since mankind first made an appearance on this planet. It would appear that all levels of society consumed various insects and today they remain an important food source in many parts of the world. Insects are important to Australian aborigines, as well as African, Middle Eastern and Asian populations. Filipino farmers flood their fields to capture mole crickets that are sold to restaurants while the Thais eat crickets, grasshoppers, beetle larvae and dragonflies. During the Pacific war prisoners supplemented their diets with insects. Aztecs favored the corn ear caterpillars while in China, bee larvae is eaten raw or fried.

Of course for the average person, a good steak and a salad would be your first choice but during uncertain times, it is always good to have alternatives such as insects. Insects are low in carbohydrates, high in protein along with fat and calories which are needed in a survival situation. For example, crickets and

grasshoppers have approximately 24 percent protein. Grasshoppers have 200 calories per 100 grams (approximately 900 calories per pound - some studies show up to 1,200 calories per pound) with 7-9 percent fat comparing to steak at 250 calories per 100 grams. Also crickets have amino acids required in the human diet. Beef provides 200-300 calories per 100 grams with 18 percent protein and 18 percent fat.

Unfortunately, they do not weight much and it will take a rather large quantity to feed you but they can be a food of opportunity - so if you find them, use them. Also, they do not need to be the main course of a meal. You may only find a few of this and that type of insect so mix and match and use them all.

In a food shortage situation, raising insects takes minimal space, they are quite, and are not very demanding in food requirements. Also, insects are what they eat which is more appetizing than what catfish and shell fish eat or even pigs.

Unfortunately most of what we eat has a cultural basis. For example how many like blood pudding. In addition, when anything is prepared in a readily acceptable form, it can be consumed without any problem. For example, if an insect was dried and ground into flour, mixed in a soup as thickener, to fortify bread, cakes and other flour based food, no one would be the wiser. We now consume red dye 56, MSG and a variety of other additives without even a thought of their source or what they can do to our bodies.

INSECT NUTRITION

Insect nutrition is varies from source to source but the bottom line is that they are nutritious. In 1970 at the United States Air Force Air War College in Montgomery, Alabama, I found the following information in a Survival Nutrition Information Bulletin #8 - Insects as a Food Source of Nutrients.

EDIBLE INSECTS

Now that you have some background information, let us explore the edible insect world. The following is provided for informational purposes only. Experiment at own risk. I have not tried many but not all of the following.

Amphibians

Although not insects, salamanders, frogs and tadpoles are edible. Mexicans throughout history have eaten them. During Mexico's early history, frogs and tadpoles were sold live in Acapulco and stewed in a tomato-chili broth thickened with corn flour and rattlesnakes and served with hot sauce. Avoid frogs that are brightly colored or that have a distinct "X" on their backs. Do not eat toads because some emit poisons through their skins. In early Mexican history salamanders were readily eaten. They were roasted two at a time wrapped in corn leaves.

Ants

Ants and ant larvae are edible (except fire ant) and tasty. The formic acid mostly disappears when they are boiled.

Black ants can be eaten raw whereas fire ants are not considered to be edible.

Certain tribes of Native Americans produced what is said to be a flavorful honey-ant wine. Ants generally have a vinegar flavor because they're loaded with formic acid, a chemical similar to the acetic acid in vinegar. In other countries such as Thailand, they sometimes substitute ant juice when recipes call for lemon. Larger ants can be squeezed onto your fresh wild salad.

Beetles

Both the adults and larvae of cicadas, Japanese beetles, June bug and floor beetle insects are edible.

Caterpillars

Caterpillars are edible but the smooth ones are best. Survival manual recommend not eating the brightly colored ones. On the other hand, the brightly colored tomato worm is edible.

Cockroaches

It may be hard to believe but cockroaches are edible but some military manuals indicate nutrition is low. Obviously, they are a prime candidate for gut purging due to their poor food source.

To purge, keep them contained in a fisherman's cricket tube or a cricket raising box for several days. For water and a good food source to purge their system use wet lettuce or piece of apple. Remember cockroaches are fast and they can fly.

When ready to eat, put them in the freezer to kill, and then remove heads, legs and wings and cook. You will find some have an odor. Also, this is one insect that must be cooked due to parasitic worms they carry. For most to stomach the thought of eating a cockroach, the specimens should be baked dry and ground into flour for mixing with a soup.

Crickets and Grasshoppers

Crickets and grasshoppers can add protein, calories, fat and variety to a meager diet.

Crickets to include mole crickets and Mormon crickets and grasshoppers are the most common insects eaten worldwide. All are edible to include at all stages of their life cycle.

Earthworms

Earthworms have a nice concentration of protein in a little package near 70 percent on a dry weight basis and they are entirely edible and abundant to collect. They are edible both raw and cooked.

Fly Larvae

The faint of heart need not apply and should skip this section because fly larvae are maggots. It is said that in any food shortage situation, the very young and the very old starve because they are not willing to adapt to new and sometimes un-tasteful foods. I have emotionally made the commitment that will not be my case.

There has been research into using fly larvae from the soldier fly to grow edible larvae for livestock. University of Georgia entomologist Craig Sheppard estimates the waste from a standard 100,000-bird chicken house seeded with soldier fly eggs will produce 66 tons of animal feed larvae in five months. They can be cooked, dried and mixed in with conventional animal feeds. They are 42 percent protein. Maybe soon it will reach the grocery store shelves.

I have a friend who was in Korea. He was involved in orderly evacuation (retreat as some would recall) as the Americans withdrew south. His job was to insure the convoys made the correct turn at a major intersection. As the last of the convoy was making the turn, he asked the driver if he was the last truck. The driver thought there were one or two more stragglers. Finally, down the road a lowboy with a tank on it rounded the turn. Unfortunately, the tank had a large red star on its side. He watched in dismay as the turret turned his way and realized it was time to run into the woods. A few seconds later, his only transportation south exploded. He later found a small village where he stayed for several months until the area was retaken by the Americans. After a diet of mostly rice, he heard the only oxen the village had died. The thought of a steak dinner made him ecstatic.

Even today, my friend cannot eat rice - even one piece of rice on a steak will make him lose his appetite. Also, he says you can tell the maggots from the rice because the maggots look like a piece of rice with a black head.

Fly larvae are commercially available for biological research and as food for some pets. A local pet store may be a source of information. In the natural, they are easy to capture and often found in clusters in such places as road kill and they are high in calories and protein.

One way to remove the larvae from decomposed meat is to place the meat in a box with openings in the bottom corners with containers under the openings. The larvae will crawl to the corners where they will fall into the containers. Bright lights seem to aid in driving the larvae off into the containers. Wash in cool water and cook. Another method is to place larvae in an old sock and rinse in cool water a couple of times. Then remove larvae and boil for five minutes and add a bullion cube. When the cube is dissolved, you are ready for your stew.

Honey Bees

Honey bees are accepted around the world as a favored food. They are edible at all stages (larval, pupa and adult) of growth. Boiling tends to break down their poison which is basically protein and at boiling temperatures, the stinger softens. Also pounding them before boiling is effective.

Mealworms

Mealworms are easy to prepare and are tasty additions to any recipe. They like crickets have an oily, nutty flavor. One cup of mealworms weighs up to six ounces. Store and freeze the larvae in plastic bags for future use. Prepare as with other insects.

For a starter stock, they are readily available from pet dealers along with directions for raising them. The mealworms you purchase will be packaged with bran or newspaper. They are easy to raise if you have a source of bran meal. Begin with shoe boxes or plastic containers. Fill with four inches of bran meal or cream of wheat and add 25 or more mealworms. The moisture and additional food required for growth is provided by an apple or potato slice placed on top of the bran. Replace moisture source every seven to ten days. A thin layer of shredded paper is placed on the meal for the adult beetles to crawl on. No cover is needed because the beetles will not crawl out of the container. Add additional meal as needed. As excess grey granular waste material is sifted out with a kitchen strainer. Once the pupa emerge into a beetle, it will lay 400-500 eggs that hatch into larvae in two weeks. The larvae grow to one inch long before they pupate. Then they become an adult beetle in two or three weeks.

In a survival situation mealworms will eat any crushed grain or weed seeds. Remember moisture is best provided by a potato or other moist root or fruit.

Mayflies

Mayflies are edible and are good. Prepare as with other insects.

Moths

Moths that you find flying around your lights are edible and taste pretty good - a little bit like almonds. Prepare as with other insects. Moth larvae provide about 265 calories per 100 grams. They are about 63 percent protein and 15 percent fat. Unfortunately, it takes a lot of moths to make a pound.

Rolli-Pollies

These little insects are found under boards and rocks in moist places. They are crustaceans and related to lobsters. Boil in water and eat as a protein source. They have a crunchy taste.

Scorpions

Scorpions are edible. Remove any hard parts to include the tail. Prepare as other insects.

Silverfish

Silverfish are edible. Prepare as with other insects.

Snails and Slugs

Escargot anyone? Again, not an insect but they are a good food resource. Both aquatic and terrestrial snails are edible and excellent source of food. According to an entomologist friend, slugs should be edible. He suggested they be boiled in vinegar to remove mucous then stir fry in butter and garlic salt.

Termites

Termites are the second most eaten insect in the world next to grasshoppers. Tropical varieties are very large. Live termites provide about 350 calories per 100 grams with 23 percent protein and 28 percent fat.

Tropical varieties are very large while local varieties are normally too small - termites in the Southeast are much smaller than those in the Western United States. But if you find a collection under a log as I have occasionally found, throw them in whatever is for dinner.

Wasps

Wasps are edible if thoroughly boiled to break down their poison which is basically protein and at boiling temperatures, the stinger softens. Also pounding them before boiling is effective. Wasp larvae is delicious. Prepare as with other insects.

Other Information

Acquiring Insects

By far the most difficult part of attempting any insect recipe is acquiring the necessary ingredients. Insects are rarely sold in supermarkets. Therefore, those who wish to eat insects must acquire them either by catching insects in the wild, by buying insects from pet stores or bait shops, or by raising their own. Catching insects in the wild, unless you're fortunate enough to live in a rural area, is a laborious and potentially dangerous task. Collect only if you're sure that the insects you're collecting are edible, and that the area where you're collecting is free of pesticides. Cicadas, field crickets, grasshoppers, grubs, tomato hornworms, and so forth, are among the edible insects one is likely to find on such hunting expeditions. Buying insects is the easiest way to get edible insects, but it is also the most expensive. Most pet stores and bait shops carry crickets and mealworms, two of the most easily raised and prepared insect species. You can also buy these insects in bulk from various insect suppliers. The only preparation that you need give to insects acquired in this manner is that of feeding them for a few days on fresh grain; most insects you buy at bait shops or pet stores have been eating newspaper, sawdust, or similar packing material, which, while completely harmless, might affect the insect's taste if you ate them while the material was still in their digestive tract. Raising insects, is the optimum way of ensuring a steady supply of palatable insects. While not entirely as convenient as simply visiting the pet store whenever you need insects, it is far cheaper, more environmentally friendly, and more rewarding in the long run.

Preparation

Those who are accustomed to eating animals probably know that most animals must be killed, cleaned, and cooked before one can eat them. The case is similar with insects. Although people in many other countries prefer to eat live insects as you will read below, it is always good for a beginner to start with dead insects.

To prepare crickets or mealworms:

Take the desired quantity of live insects, rinse them off and then pat them dry. This procedure is easy to do

with mealworms, but fairly hard to do with crickets. To do so with crickets, pour them all into a colander and cover it quickly with a piece of wire screening or cheesecloth. Rinse them, then dry them by shaking the colander until all the water drains. Then put the crickets or mealworms in a plastic bag and put them in the freezer until they are dead but not frozen. Fifteen minutes or so should be sufficient. Then take them out and rinse them again. You don't really have to clean mealworms, though if you want, you can chop off their heads. Cricket's heads, hind legs, and wing cases can be removed according to personal preference; I like doing so, since cricket legs tend to get stuck in your teeth. You are now ready to use the insects in all kinds of culinary treats!

Notes:

1. Once insects die, their postmortem changes happen quickly making them unpalatable soon after they die...so you have to cook them alive like you do a lobster. If you collect your own crickets or buy them live from a supply house, you can put them in the refrigerator until you are ready to roast them...this will not kill them only slow their metabolism down (so don't worry about them crawling around the fridge!!). This also makes them easier to prepare as they are not trying to crawl away from you while you arrange them on the cookie sheet. You can also buy frozen crickets from supply houses but they do not taste as good when cooked.

2. If you buy crickets from a supply house, they are usually wrapped in newspaper (or other paper). It is best to "purge" them to get the paper and ink out of their bodies. To do this, feed the crickets chunks of apples and/or potatoes for 24 hours before you cook them.

PREPARATION BASICS

First remove any dead insects. Those that are alive will have to be slowed down by placing in a refrigerator for several hours. Remove and place in a kitchen colander and toss them while blowing or using a hair drier to separate the debris from the crickets. The small debris will pass through the colander and the other will blow away. Pour out the crickets on a paper towel or wax paper. If you have not removed the dead ones before putting in the refrigerator, then remove them now. Rinse in cool water, drain, pat dry with a paper towel and use immediately or freeze in a plastic bag for later use.

To use, you may or may not want to remove the legs and wings. Some recommend removing the heads because they have no food value but I prefer to not remove anything. If you prefer to remove parts, the procedure works best when the insect is frozen or already dry roasted.

Insects with a hard outer shell have parasites and a few are transferable to humans, so cook them before eating. Grasshoppers, in particular, can carry several parasitic worms that can be passed to humans as does beef. Most other insects can be eaten raw but cooking normally improves their taste.

Do not eat insects such as spiders, mosquitoes and some ants such as the fire ant or insects that have a pungent odor.

Insects are best if cooked or frozen while alive. Once insects die they can become unpalatable. Actually insects can be kept alive for several days in a refrigerator. Freezing or refrigeration serves two purposes. The insects can be collected over a period of time until an adequate quantity is gathered and the more lively insects will be slowed down for easier preparation.

Larvae are easier to eat than adult insects. This is because young insects are usually soft like caterpillars. The hard covering of most adult beetles and the wings and legs of most other adult insects are just too tough for most people's taste and therefore have to be removed. Not all adult insects are too crunchy to eat. Some, like crickets and grasshoppers are soft enough to chew.

If you have concerned about what may be in an insect's gut, it can be purged. Crickets and meal worms can be purged by allowing them to eat slice of apple, potato, pear or leafy vegetable for 24 hours. Or to purge the gut of your insects before eating, separate them from their food for 24 hours. I do know that crickets and mealworms will turn cannibalistic but some purging may be appropriate.

In general it is best to crush or use a blender on your insects and cook in a stew to disguise their appearance. If at any time you find you can not eat an insect, do not despair. Take the insects and boil in a pot of water. The fat will rise to the top. Scoop it up and drink. Or as is done in Japan with grasshoppers, boil in soy sauce to get a grasshopper that tastes sort of like a soy-sauce flavored potato chip.

Boiling

- 1-2 cups insects
- 2-4 cups of water
- salt and pepper to taste
- 1 tablespoon butter
- 2 tablespoons chopped onion.

Place in pan and simmer for 30 minutes or until tender.

Sautéed

- 1-2 cups insects
- 1/3 up butter
- 3 cloves garlic

Melt butter, add garlic sauté for several minutes to blend flavors and then add insects. Sauté for an additional 10 minutes or until tender. My favorite method of cooking crickets and grasshoppers.

Dried

Insects placed on a paper towel can be baked on a cookie sheet at 150-200 degrees for one or more hours until dried. An alternative is to freeze the insect in a plastic bag overnight, then blanch them to remove any debris or contaminates. Next take off the head and legs and bake them for about two hours until dry. You will now have an insect that will fit into most recipes. In the outdoors, they can be killed and then placed on a hot rock to be solar dried.

Flour

After insects have been dried, they can be made into flour using a blender.

Soup Stock

Save the liquid when boiling insects for use as soup stock or liquid for cooking other foods. Use immediately or freeze.

Smoked

Insects can be frozen for later use.

Patties

Finely chop a cup of insects in a food processor with an egg, half a small onion, season with salt, pepper or even hot chili and enough bread crumbs to form a dough. Mold the dough into patties and grille or pan fry until brown

To Make Insect Flour:

Spread your cleaned insects out on a lightly greased cookie sheet. Set your oven 200 degrees and dry

insects for approximately 1-3 hours. When the insects are done, they should be fairly brittle and crush easily. Take your dried insects and put them into a blender or coffee grinder, and grind them till they are about consistency of wheat germ.