



FLOWERS YOU CAN EAT

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YOUNG REVIEWERS:



HUDSON

AGE: 10



KATHINE

AGE: 14



SARAH

AGE: 15



**SCUOLA IC
PICENTIA.**

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AGES: 11–14

Edible flowers are made up of a large group of flowers that have different characteristics. In addition to being delicious, they can also be healthy and nutritious. In this article, you will learn about the science behind flower eating, including the super-healthy nutrients they contain and how these nutrients can change when the flowers are cooked. We hope that this article, and our work studying edible flowers, will help spread the knowledge about flowers as food. Many people still might not know that some flowers are much more than decorations—they can actually be eaten as part of a healthy diet.

INTRODUCING EDIBLE FLOWERS

Flowers are the parts of some plants responsible for plant reproduction. You have almost certainly seen flowers during the spring season—they usually have very striking colors, and many have a beautiful smell. Although flowers are mostly used for decoration in homes and gardens, they can also be used as nutritious food or even as medicine. Just as some leaves, stems, roots, and fruits are **edible** while others are not, some flowers are also edible, too. But be careful, not all flowers can be eaten! There are some very showy flowers that could even harm your health, so remember to always consult an adult before eating anything.

When it is the flowering season, many plants produce edible flowers (Figure 1). People pick them to sell them or to eat them themselves. The practice of eating flowers for food and nutritional purposes is called **floriphagia**. Although floriphagia has increased in popularity in recent years, history indicates that on the American, Asian, and European continents, edible flowers have been used since ancient times—well before your grandparents were even born [1].

EDIBLE

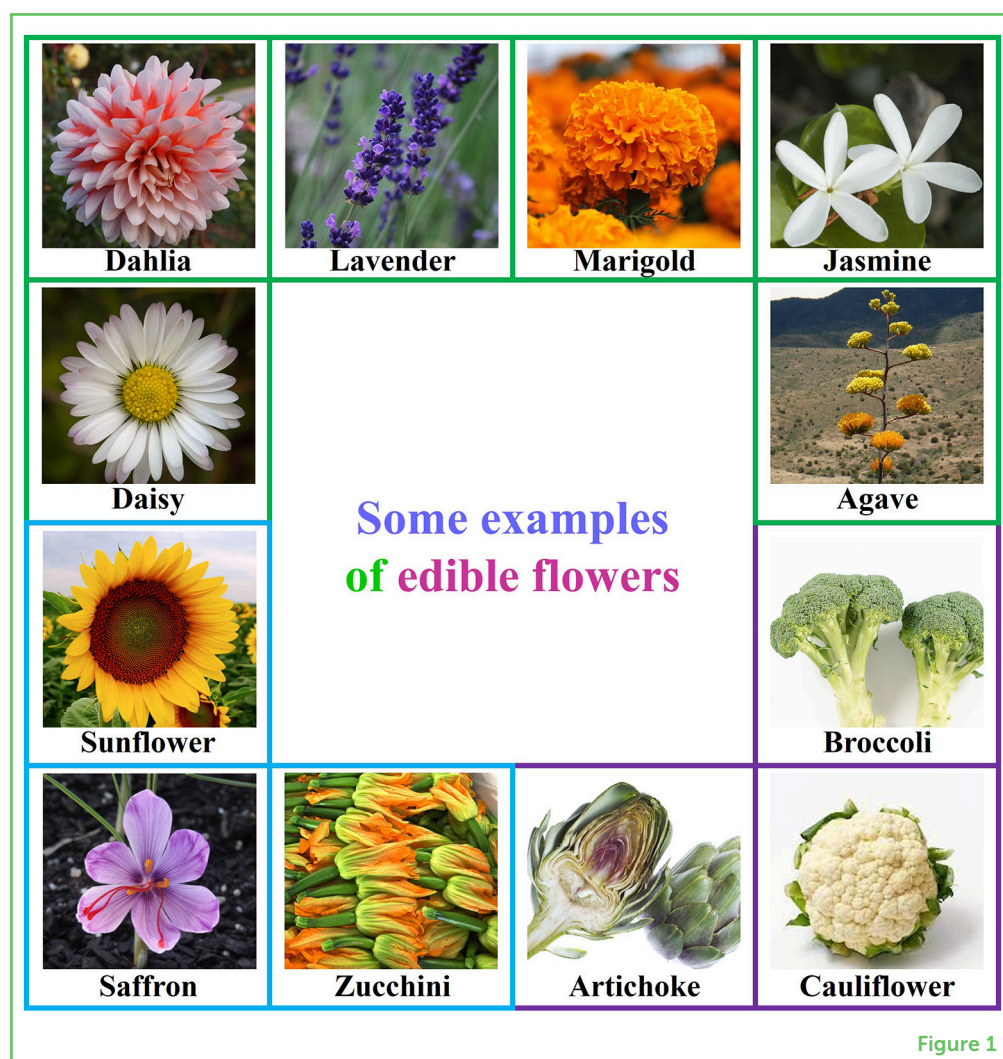
That can be eaten.

FLORIPHAGIA

Activity that consists of consuming flowers.

Figure 1

Some of the best-known edible flowers (blue squares), those you may not have known you could eat (green squares), and those you probably did not even know were flowers (purple squares). Original photos available at: <https://www.flickr.com/>; Creative Commons License: CC BY-SA 2.0.



Some of the best-known edible flowers include squash (including butternut and zucchini), pumpkin, sunflower, dandelion, and saffron. There are other flowers, such as dahlia, jasmine, daisy, marigold, lavender, and more, that you probably did not know you could eat. Finally, there are broccoli, cauliflower, and artichoke. These vegetables are also flowers, but even though you have probably eaten them at some point, you may have not known that you were eating flowers.

Nowadays, flowers are consumed in a wide variety of ways in different parts of the world. Some of them are used as decorative elements in dishes prepared by chefs, while others are consumed as fresh ingredients in salads, and still others are used as the main ingredient in hot recipes such as soups, broths, beverages, and more [2]. Edible flowers are consumed in so many ways because they have different characteristics: flavor, color, size, and thickness. Also, the geographical, social, and cultural environments of the region where the flowers grow influence the way they are eaten. For example, in Mexico, a very common way to use squash blossom is as a filling for tacos and quesadillas (a taco filled with cheese). Although, in other parts of the world, squash blossoms are used as an ingredient to prepare soups and creams.

EDIBLE FLOWERS ARE NUTRITIOUS, TOO!

On top of having a very nice taste, color, and smell, edible flowers are also very nutritious. For example, they have **macronutrients** such as proteins, carbohydrates, and healthy fats. These macronutrients give you the energy to get up every morning and go to school, do a sport, or almost never get tired of playing. Did you know that not all foods have the same amounts of macronutrients? That is why some foods are healthier than others. Well, it is the same with flowers. If we take protein as an example, there are flowers such as those from pumpkin and yucca that have up to 20 times more protein compared to other flowers.

We know you might already be anxious to try eating some flowers, and the same thing happened to us, but do not do it yet. There is still more to learn, because inside the flowers there is something so cool that you will not want to miss it. **Bioactive compounds** are like superheroes—they are very small molecules found in flowers and other plant-based foods. The best-known bioactive compounds include phenolic compounds, flavonoids, and vitamins. But there are also bioactive compounds called **pigments**, which make foods have certain appealing colors. These pigments are chlorophyll, carotenoids, and anthocyanins (Figure 2).

Why are the bioactive compounds like superheroes? Well, first of all, they each have their own specific colors. First, there are the

MACRONUTRIENTS

Nutrients that are found in large quantities in foods and that provide energy when the food is consumed.

BIOACTIVE COMPOUNDS

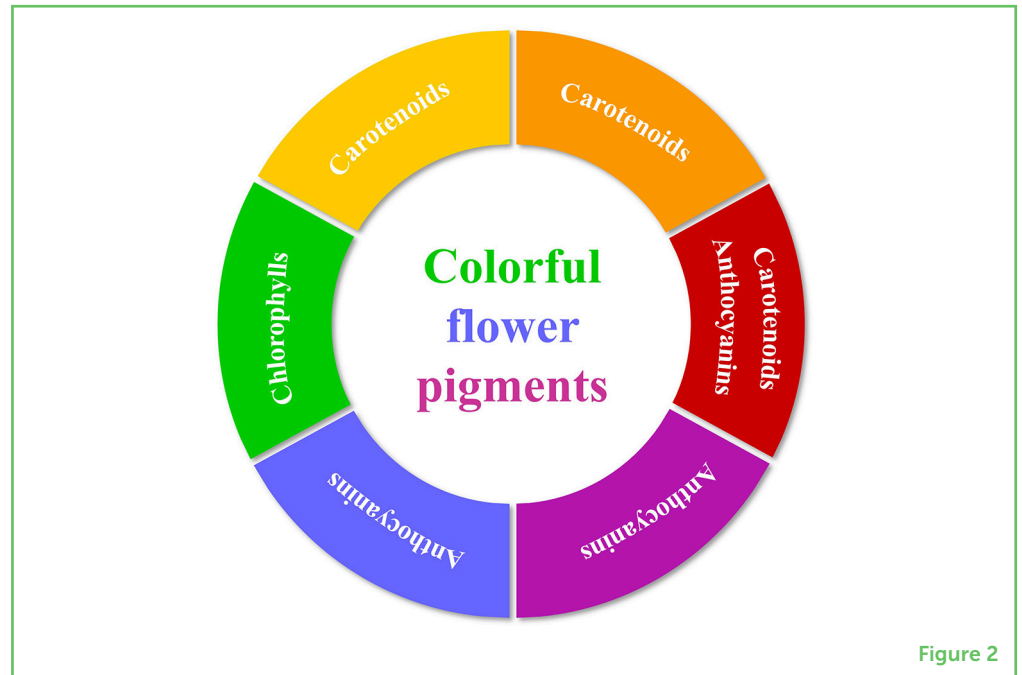
Very small components of plants that are beneficial to human health.

PIGMENTS

Those bioactive compounds that give color to plants and other foods.

Figure 2

Pigments are bioactive compounds that give plants their colors. Chlorophyll is a pigment found in green flowers. Carotenoids are present in yellow, orange, and red flowers. Anthocyanins are found in blue, violet, and red flowers.



chlorophylls, which exist in green flowers, so they are like the Hulks of pigments. Then there are the carotenoids, which give flowers their characteristic red and yellow colors, just like Iron Man. Finally, we come to our favorite, a pigment that has red and blue colors... do you know which superhero is that color? Exactly! It is Spider-Man. But what would superheroes be without their superpowers? Well, bioactive compounds help prevent and fight diabetes, obesity, hypertension, Alzheimer's disease, as well as some types of cancer and many other illnesses.

WHAT HAPPENS WHEN EDIBLE FLOWERS ARE COOKED?

Many flowers are typically eaten raw. However, some flowers need to be cooked before we can eat them (Figure 3). Some of the most common ways to cook flowers are in hot water (boiling) or steam (steaming), in a little bit of oil (stir-frying) or in a lot of oil (frying), but they can also be baked in the oven or cooked by some other method. Cooking is very important, since it usually has consequences for the properties of food (Figure 3). During cooking, the heat creates tasty flavors and smells, so if you cook flowers, they will definitely be tastier. Also, cooking breaks down proteins and carbohydrates [3], making the work of the **digestive system** easier as it makes the bioactive compounds available to your body.

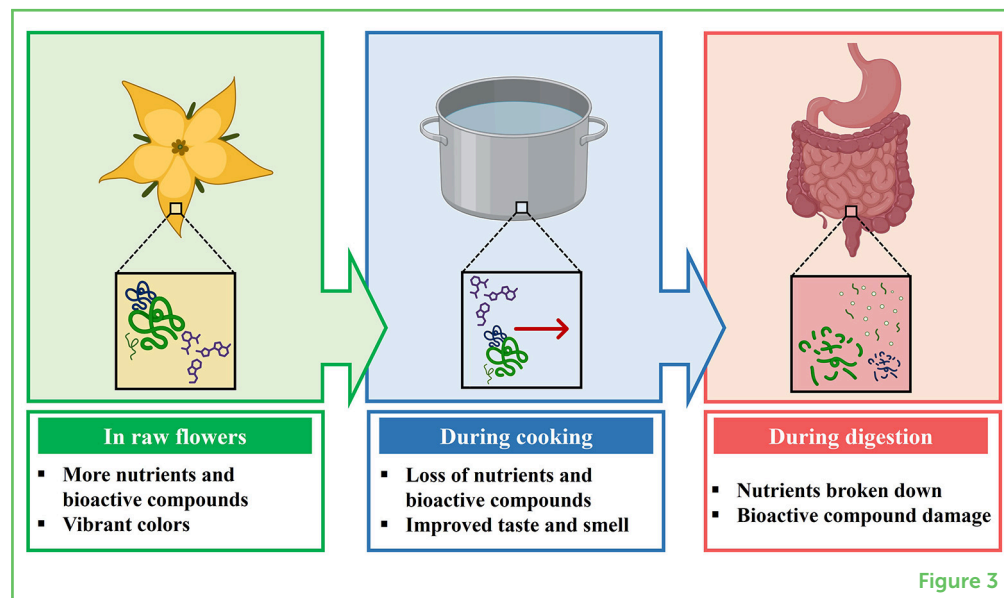
However, not everything about cooking flowers is positive. The bioactive compounds in flowers can be reduced by cooking because they are sensitive to heat. Also, during cooking, water or oil enters the

DIGESTIVE SYSTEM

The set of organs responsible for breaking down foods to recover the nutrients food contains.

Figure 3

Some characteristics of raw edible flowers (green), and the changes that occur in flowers when they are cooked (blue) and when you eat them (red).



flower tissues and causes the bioactive compounds to move outwards. It is as if the cooking water or oil steals these valuable compounds from the flowers. Cooking flowers for a longer time can result in a greater loss of bioactive compounds and, consequently, the loss of healthy effects that flowers can have on the body. Therefore, cooking flowers for short times could be a better option, preserving the highest amounts of bioactive compounds and ensuring that the flowers are both delicious and healthy.

ENJOY... WITH CAUTION

We hope that reading this article was a good introduction to the fascinating world of edible flowers, including some of the science behind it! To finish up, we will give you some final recommendations. Most importantly, remember that not all flowers can be eaten! Always consult with an adult to avoid eating any plant that might be risky for your health. Additionally, not all flowers should be consumed raw and not all should be cooked... although there are flowers that are commonly consumed both raw and cooked. If you plan to try edible flowers, we recommend researching how each type should be used, in recipe books and using reliable sources on the internet. While you cannot control what happens to the nutrients of the flowers inside your body, you *can* be as knowledgeable as possible about the way you prepare them, so that you cause as little damage as possible to the beneficial compounds. For example, in research we recently conducted in our laboratory, we found that steaming edible agave flowers for up to 5 min best preserves their bioactive compounds [4]. So, when you want to cook flowers, keep in mind that steaming may be a good option—and remember that bioactive compounds are the colorful superheroes of this story!

REFERENCES

1. Mulík, S., and Ozuna, C. 2020. Mexican edible flowers: cultural background, traditional culinary uses, and potential health benefits. *Int. J. Gastron. Food Sci.* 21:100235. doi: 10.1016/j.ijgfs.2020
2. Mulík, S., Hernández-Carrión, M., Pacheco-Pantoja, S. E., Aguilar-Ruiz, N., and Ozuna, C. 2022. Culinary uses of Mexican edible flowers: recipe analysis. *Int. J. Gastron. Food Sci.* 28:100539. doi: 10.1016/j.ijgfs.2022.100539
3. Castañeda-Rodríguez, R., Quiles, A., Hernando, I., and Ozuna, C. 2024. Cooking methods determine chemical composition and functional properties of squash blossoms: a study of microstructural and bioaccessibility changes. *Food Res. Int.* 180:114095. doi: 10.1016/j.foodres.2024.114095
4. Castañeda-Rodríguez, R., Larrea, V., Hernando, I., and Ozuna, C. 2023. Cooking changes agave flower properties, including the bioaccessibility of bioactive compounds. *Int. J. Gastron. Food Sci.* 32:100749. doi: 10.1016/j.ijgfs.2023.100749

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YOUNG REVIEWERS

HUDSON, AGE: 10

I like playing video games, Minecraft is my favorite. I enjoy reading manga and playing sports like running, ultimate frisbee and hockey.





KATHINE, AGE: 14

Hi! I am 14 years old and I enjoy learning about science. I like to play tennis and enjoy going out for bubble tea with my friends.



SARAH, AGE: 15

My name is Sarah. I dance and paint, these activities allow me to express myself creatively. Additionally, I am extremely interested in different fields of science, especially biology and physics.



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Teresa Sofia

I am 11 and want to become a scientist when I grow up. At school, I recently learnt about plants. I love computers, science, and technology.

Alessandro

I am 12 and want to become an astronaut or engineer. I recently studied motion in my class and am fascinated by space (black holes, neutron stars, and galaxies). I am very concerned about global warming.

Alfonso

I am 14 and I want to become a writer. Recently, I learned about earthquakes and the Mendel's laws. I have been following the development of recent wars, and I am concerned about the inappropriate use of nuclear energy.

AUTHORS



REY CASTAÑEDA-RODRÍGUEZ

I earned my master's degree in biosciences at Universidad de Guanajuato in Mexico in August 2022. Currently, I am a collaborator and active member of Food Innovation and Technology Lab in Mexico and at the same time I am looking for options to study for a doctorate. My research interests include the study of physicochemical, bioactive, and antioxidant properties of various Mexican products including Mexican edible flowers, which I have studied for more than 4 years.



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My research interests include Mexican cultural heritage, including traditional culinary products as well as Mexican Indigenous languages. In addition to a masters' degree and a doctorate in linguistics, I obtained a master's degree in chemistry in 2007 from VUT (Brno, Czech Republic). I have collaborated on various projects related to Mexican culinary products.



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I am a professor of food science at the Universitat Politècnica de València (UPV), Spain. I am a member of the research group "Microstructure and Chemistry of Foods (MIQUALI)" at the Research Institute FoodUPV (UPV). My main lines of research are related to the revaluation of by-products, emulsions, or structuring of oils and food reformulation using new and healthy ingredients. I have published more

than 90 scientific articles in international journals, more than 120 contributions to conferences, and 10 book chapters. I have also contributed with two patents.



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