Carnivorous plants.

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To understand carnivorous plants, it is necessary, first, to understand the habitat in which they are located. They tend to develop in environments with nutrient-poor, waterlogged, and mostly acidic soil. These adverse and scarce conditions require different strategies and traps for their nutrition. Also called insectivorous, this species captures prey to use as a nutritional supplement. It can be observed that different species adapt to the natural environment extremely easily. They transform according to the needs that survival in each territory requires. The carnivorous plant is the result of this process. The presence of a digestive enzyme allows the carnivorous plant to feed differently from other plants (Figure 1) [1-3].

Figure 1. Carnivorous plants with their prey (fly) inside. Source: https://animals.sandiegozoo.org/plants/carniverous-plants

Carnivorous plants occur predominantly in the tropical zone of the planet, with great biodiversity occurring in Southeast Asia, the Americas, and Australia. A smaller number of species occur in southern Europe and Africa, with those best adapted to their habitat being found in inhospitable places such as Alaska, Scandinavia, and the Australian desert. There

are four main families of carnivorous plants: Nepenthaceae, Sarraceniaceae, Droseraceae, and Lentibulariaceae. They are extremely distinct from each other concerning their reproductive structures, which indicates that they may have evolved in parallel and that their ability to capture and digest is an evolutionary convergence. However, some capture strategies are similar, as in animals (Figure 2) [4-6].

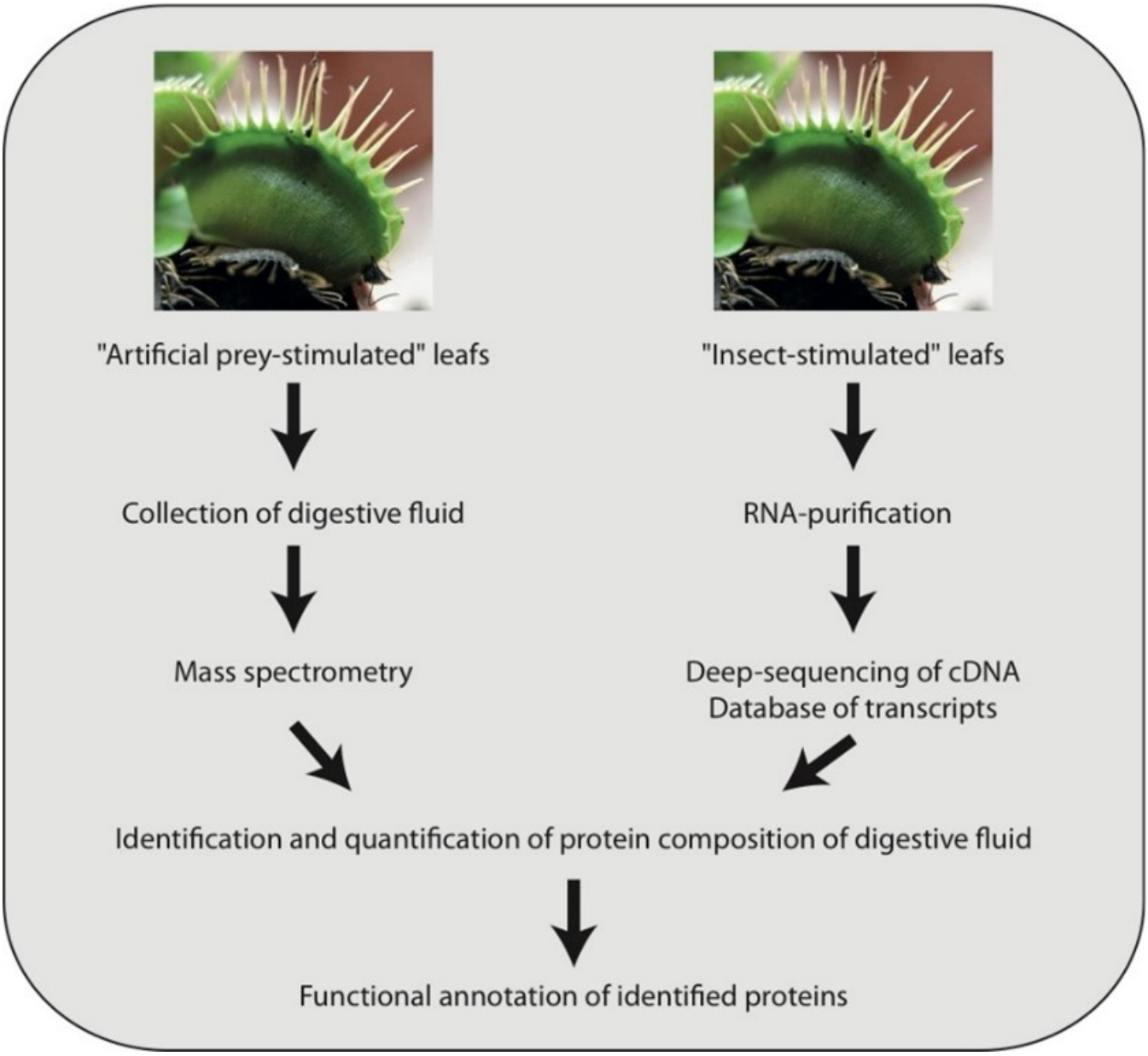

Figure 2. Workflow of the Venus flytrap digestive fluid analysis. Source: Figure: Kristian Wejse Sanggard.

They are generally small plants, a few centimeters tall, not exceeding 15 cm. In a process of evolution, carnivorous plants adapted to use their digestive system to feed on insects. Carnivorous plants can be attacked by sucking insects such as aphids, chewing insects, worms, and beetles just like any other plant. They are susceptible to diseases caused by fungi. Therefore, they must be constantly monitored. Most species have passive capture mechanisms, such as traps with perfumes or other odors that serve as bait for insects. Some genera present macroscopic movements based on

mechanical stimuli to capture prey and subsequent digestion. The most famous representative of this group is *Dionaea* sp. Carnivorous plants are very easy to grow and seedlings must be purchased from authorized producers. They don't require much care other than irrigation. They are very demanding when it comes to humidity, both in the substrate and in the environment (Figure 3) [6-8].

Figure 3. *Nephentes rajah* Hook.fil. (Nepentáceas). It is a species endemic to Mount Kinabalu and Mount Tambuyukon in Sabah, Borneo. N. Rajah grows exclusively on serpentine substrates, particularly in infiltration areas, where the soil is loose and permanently moist. Source: https://super.abril.com.br/mundo-estranho/qual-a-maior-planta-carnivora-do-mundo.

The leaves that form the traps are rich in modified cells that have functions like those of cells in the digestive tract of animals. They secrete substances that reduce the pH of the environment and digestive enzymes, which are more efficient in an acidic environment. The same or different cells present in the traps absorb the digested material Bees, which carried approximately 20 pollen grains each, were the most important pollinators of *Dioneia* sp. A differentiation, on the part of the plant, of which insect is a meal and which is a pollinator [8-10].

Species of carnivorous plants:

Dionaea muscipula Werewolf (Droseraceae).

Known as a "T" type trap that it uses to capture its prey, it mainly attacks small insects, such as mosquitoes and flies. It is one of the best-known carnivorous plants in the world, but it is native to the swampy regions of the southeastern United States. Small in stature, this species is between 10 and 15 cm tall and its leaves have a shape that characterizes its trap, mainly due to the presence of the thorns it has. This species produces nectar that attracts insects and, when touching the leaves, the prey is perceived in the sensory hairs. The trap closes quickly, forming a kind of cage for the animal (Figure 4) [10-11].

Figure 4. Each leaf of a Venus flytrap is a trap:*Dionaea muscipula* Werewolf (Droseraceae). Source: https://animals.sandiegozoo.org/plants/venus-flytrap.

The carnivorous plant species of African origin is considered one of the most common species in cultivation. This species of carnivorous plant has several leaves that measure around 3.5 cm long and 0.5 cm wide. They are full of seeds that attract insects, which in turn adhere to the sticky substance released. After capturing the prey, the leaf begins to curl so that the gastric glands begin to act, starting the plant's digestive process. This process takes approximately 30 minutes [11-12].

The Venus flytrap produces white flowers on long stems that appear in the center of the plant. Therefore, these flowers are attractive to pollinators such as bees and other insects. After pollination, the plant produces seeds that can be collected and germinated to grow new seedlings. The Venus flytrap requires adequate sunlight to carry out photosynthesis and develop properly. For plant development, place the plant in a location where it receives at least 4 to 6 hours of direct sunlight per day. However, avoid exposure to intense and prolonged sunlight, as this can damage its sensitive leaves. Therefore, a good option is to place the Venus flytrap in a location that receives filtered or indirect sunlight [11-13].

Nepenthes bicalcarata Hoo.f. (Nepenthaceae)

A species of suction-type carnivorous plant, it uses its shape like a pitcher to capture prey. Native to Borneo, close to Malaysia, this species can be found in specific environments such as white sand forests and the shade of other species from the plant kingdom. The ideal climate for its development is hot and humid places. Its pitcher shape, called ascidian, is a modified leaf that favors the accumulation of nectar to attract insects. When capturing prey, enzymes that aid in digestion are released (Figure 5) [12-13].

Figure 5. *Nepenthes bicalcarata* Hoo.f. (Nepenthaceae). Source: https://www.todamateria.com.br/plantas-carnivoras/.

Darlingtonia californica Torr. (Sarraceniaceae).

Known as the snake plant, D. californica also belongs to the group of carnivorous plants. The ingenious plant captures the insects through the hole through which they enter and is then enveloped in a viscous, immobilizing secretion. This secretion in turn contains microorganisms and enzymes that degrade insects by digesting them (Figure 6) [13-14].

Figure 6. *Darlingtonia californica* Torr. (Sarraceniaceae). Source: https://en.wikipedia.org/wiki/Darlingtonia_californica.

Drosophyllum lusitanicum (L.) Link (1806) (Drosophyllaceae).

Belongs to the group of carnivorous plants. This plant has thick, short stems and the leaves unfold through a central rosette, covered by glands with a sticky substance that allows it to capture and digest prey (insects) (Figure 7) [14-20].

Figure 7. *Drosophyllum lusitanicum* (L.) Link (1806) (Drosophyllaceae). https://www.floresefolhagens.com.br/drosophyllum-plantas-carnivoras/.

Utricularia L. (Lentibulariaceae)

These carnivorous plants don't look like carnivorous plants. *Utricularia* looks like a flower and many see similarities between species of this carnivorous plant and orchids. Aquatic, utricularias are small and bottle-shaped. They hibernate during the winter to resist the cold and use suction to capture prey when they are active (Figure 8) [14-20].

Figure 8. *Utricularia* L. (Lentibulariaceae). Source: https://www.portaldojardim.com/pdj/2020/08/30/plantas-carnivoras-utricularia/.

Sarracenia L. (Sarraceniaceae)

It is a very resistant carnivorous plant and adaptable to extreme climates. The flower of these carnivorous plants always

appears in spring, exuding an odor that attracts pollinating insects (Figure 9) [14-20].

Figure 9. *Sarracenia* L. (Sarraceniaceae). Source: https://www.gardenia.net/genus/sarracenia

Cephalotus follicularis Labill. (Cephalotaceae)

Native to a region in southwestern Australia, where it grows in coastal and constantly flooded areas. Your trap, which is nothing more than modified leaves. It can be grown in indirect sunlight, so the plants will grow larger, but with greenish pitchers; In direct sunlight, the pitchers become smaller but obtain a beautiful reddish color; Keep the moisture content high in an attempt to keep the liquid in); Do not leave the pots in dishes filled with water, as the roots may rot; Its growth is slow and must be planted in large pots, as the rhizomes will grow, making it possible to propagate by division (Figure 10) [14-20].

Figure 10. *Cephalotus follicularis* Labill. (Cephalotaceae). Source: http://www.northqueenslandplants.com/Australian%20Plant%20Families%20A-F/Cephalotaceae/Cephalotus/Cephalotus%20follicularis.html.

Genlisea hispidula Stapf (Lentibulariaceae).

The traps are underground or submerged and the leaves grow close to the ground, normally in a rosette. Generally, there are no true roots. Its flowers can vary in shades of white, yellow, lilac, and dark purple. *Genlisea hispidula* tolerates direct sun and moist substrate and does not require much humidity; Other species can be a challenge in cultivation, as they are fragile plants and have peculiar habitats, making it not always possible to reproduce them in cultivation (Figure 11) [14-

20].

Figure 11. *Genlisea hispidula* Stapf (Lentibulariaceae). Source: https://www.carnivoras.com.br/genlisea-hispidula-t9482.html

Dionaea muscipula Werewolf (Droseraceae).

Native to the swamps of the coastal plain of the United States, it is considered one of the most cultivated carnivorous plants in the world. The species enters dormancy in the coldest months of the year when the photoperiod decreases and the temperature drops. During this period, the size of new leaves is greatly reduced and growth may stop completely. The lighter it is, the healthier and redder the plant will be; The soil must be kept constantly moist, but it must not be soaked, as this can cause the roots and rhizome to rot; Be careful not to discard the pot during the dormant period thinking that the plant has died (Figure 12) [14-20].

Figure 12. *Dionaea muscipula* Werewolf (Droseraceae). Source: https://g1.globo.com/sp/campinas-regiao/terra-da-gente/noticia/2023/11/15/plantas-carnivoras-conheca-os-nove-generos-mais-comuns-e-como-cultiva-los.ghtml.

Nephentes rajah Hook.fil. (Nepenthaceae) largest known carvioria plant.

It is a species endemic to Mount Kinabalu and Mount Tambuyukon in Sabah, Borneo. It grows exclusively on serpentine substrates, particularly in infiltration areas, where the soil is loose and permanently moist [14-20].

Carnivorous plants have modified leaves that are called traps. These trap sheets can have different shapes and act in different ways.

Cage or bite traps: They are triggered when the prey touches them and they close, trapping the prey; Suction traps prey is “sucked” into an internal part of the plant when it comes into contact with it; Traps, pots, or urns for sea squirts: they are similar in shape to pots and inside contain a digestive liquid; Sticky or adhesive traps: they have “sticky” glands spread across the leaves or even throughout the plant that traps the prey [14-20].

Carnivorous plants can also be classified according to the movement they make to capture prey.

Active carnivorous plants: move to capture prey; passive carnivorous plants do not move to capture prey; semi-active carnivorous plants: carry out some movements after capture to increase the area of contact with the prey, which allows better absorption of nutrients 14-20].

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