

One of the components of a healthy honey bee colony is proper nutrition, which depends on the amount of nectar and pollen to provide energy and protein. When malnourished, the bee's metabolism accesses body fat stores and is vital to maintaining the health of the colony.

What nutrients do honey bees need?

Like humans, bees need carbohydrates, fats, proteins, sterols, minerals, vitamins, and water to live long and healthy lives.

Do bees need fat?

Bees obtain most of their nutrients from their primary food sources, nectar and pollen. While nectar is mainly carbohydrates, pollen contains most of the other essential nutrients: protein, fat, minerals, and vitamins.

Fat bodies:

All insects have fat bodies, which are multifunctional organs that play several vital roles in their physiology and metabolism. These organs are considered equivalent to the liver and adipose tissue of honeybees. Fat bodies store energy when food is abundant and release energy when the bee needs it.

Different functions of fat bodies:

1 -Energy storage:

Storage of fat and glycogen: Energy stored in fat bodies is especially important during larval development and other periods when food is limited, such as long flights and hibernation. Summer bees, which live for 4-6 weeks, have very little body fat (short lifespan).

Fat bodies act as a central nutrient storage center for the synthesis and use of energy reserves. Energy reserves are stored in the form of glycogen and triglycerides, which are broken down into glucose (instant energy) or fatty acids as fuel molecules when needed.

Lipid storage and utilization (fuel and metabolism) are essential for growth and reproduction and provide energy needs during long periods of nutritional deprivation. They play a dominant role during periods of starvation and high activity. Fat storage has many advantages over glycogen storage, and the energy of fats is more than twice that of glycogen and proteins. In addition, fat stores have 8 to 9 times more energy per unit mass than glycogen stores. It is noteworthy that each glucose molecule has 38 ATP molecules. Fat with one short fatty acid (single chain) is worth 48 ATP molecules, and fat with three fatty acid chains (polyunsaturated fatty acids) will be worth 144 ATP molecules. It is worth noting that 1 gram of fat provides 9 kcal of energy, so it is easy to understand why fats are a good source of energy during starvation.

2 -Nutrient metabolism:

.Fat metabolism: Fat bodies play a key role in fat metabolism. They can break down stored fats and use them as fuel for energy production or as precursors for the synthesis of other molecules.

.Carbohydrate metabolism: Fat bodies also play a role in carbohydrate metabolism. They can convert glucose into glycogen and store it.

.Protein metabolism: Fat bodies can synthesize or break down proteins. The synthesized proteins can play a role in bee growth and development, the production of enzymes and hormones, and the immune response.

3-Protein synthesis:

.Hemolymph protein synthesis: Fat bodies synthesize various proteins that are found in the hemolymph (bee blood). These proteins have a variety of roles, including the transport of molecules, the immune system, and blood clotting.

.Egg protein synthesis: In female bees, fat bodies synthesize egg proteins. These proteins are stored in the egg yolk and are essential for the development of the bee embryo.

.Synthesis of antimicrobial proteins: Fat bodies produce antimicrobial proteins in response to microbial infections. These proteins help the bee's immune system to fight pathogens.

4 -Detoxification:

.Metabolism of toxins: Fat bodies can metabolize some toxins and harmful substances and eliminate them from the bee's body. This process is called detoxification and is essential for maintaining the bee's health.

.Storage of toxins: In some cases, fat bodies can store toxins. This mechanism allows the bee to become resistant to toxic substances or use them to defend itself.

5 -Hormonal regulation:

.Synthesis of some hormones: Fat bodies play a role in the synthesis of some bee hormones. These hormones can play a role in regulating the growth, metamorphosis, and reproduction of bees.

.Response to hormones: Fat bodies respond to various hormones. For example, hormones such as adipokines affect fat metabolism in fat bodies.

6-Immune system:

.Production of immune proteins: Fat bodies play an important role in the bee's immune system. They produce antimicrobial proteins and other molecules that help the bee fight pathogens.

.Activation of the immune system: Fat bodies can activate cells of the bee's immune system and help them fight infections.

7-Regulation of growth and development:

.Provision of nutrients for metamorphosis: Fat bodies play an important role in the metamorphosis of bees. They provide nutrients necessary for the growth and development of the bee during the larval and pupal stages.

.Provision of nutrients for reproduction: Fat bodies also play a role in insect reproduction. They provide nutrients necessary for the production of eggs or sperm.

8-Production of precursors: Fat bodies also play a role in the production of precursors necessary for the manufacture of substances such as wax.

9 -Vitellogenin production: Vitellogenin is the precursor of egg yolk from lipoproteins and phosphatase.