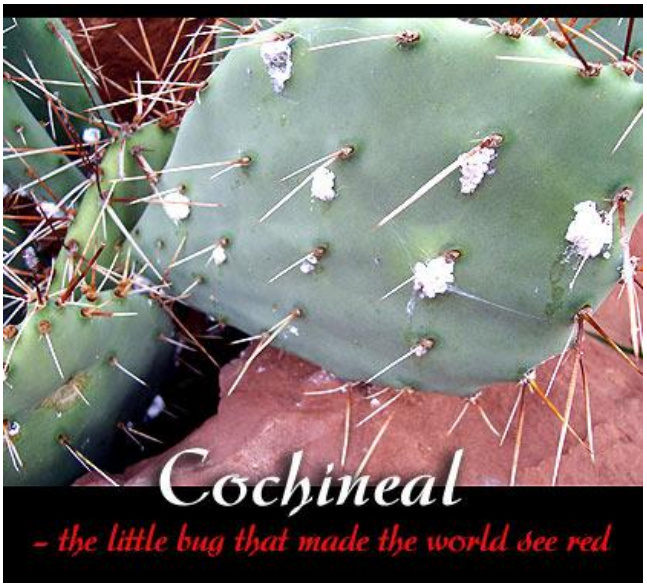

The Cochineal (COACH in EEL) is a scale insect (not a beetle, although it looks beetle-like) from which the crimson-colored dye carmine is derived. The insect lives on cacti feeding on plant moisture and nutrients. The insect produces carminic acid that deters predation by other insects. Carminic acid can be extracted from the insect's body and eggs to make carmine dye (also known as cochineal). Carmine is primarily used as a food coloring and for cosmetics.

After synthetic pigments and dyes such as alizarin were invented in the late 19th century, natural-dye production gradually diminished. Health fears over artificial food additives, however, have renewed the popularity of cochineal dyes, and the increased demand has made cultivation of the insect profitable again.

History

Cochineal dye was used by the Aztec and Maya peoples of Central and North America. Eleven cities conquered by Moctezuma in the 15th century paid a yearly tribute of 2000 decorated cotton blankets and 40 bags of cochineal dye each. During the colonial period the production of cochineal (grana fina, translated – fine grain, because the dried, crushed bugs were mistaken for grain by early Spanish explorers/conquerors) grew rapidly. Produced almost exclusively in Oaxaca by indigenous producers, **cochineal became Mexico's second most valued export after silver.** Soon after the Spanish conquest of the Aztec Empire it began to be exported to Spain, and by the seventeenth century was a commodity traded as far away as India. The dyestuff was consumed throughout Europe and was so highly prized that its price was regularly quoted on the London and Amsterdam Commodity Exchanges.

The demand for cochineal fell sharply with the appearance on the market of alizarin crimson and many other artificial dyes discovered in Europe in the middle of the 19th century, causing a significant financial shock in Spain as a major industry almost ceased to exist. The delicate manual labor required for the breeding of the insect could not compete with the modern methods of the new industry, and even less so with the lowering of production costs.

It has become commercially valuable again, although most consumers are unaware that the phrases "cochineal extract", "carmine", "crimson lake", "natural red 4", "C.I. 75470", "E120", or even "natural coloring" refer to a dye that is derived from an insect. The dye may induce an anaphylactic shock reaction in rare cases.

Biology

Cochineal insects are soft-bodied, flat, oval-shaped scale insects. The females, wingless and about 5 millimetres (0.20 in) long, cluster on cactus pads. They penetrate the cactus with their beak-like mouthparts and feed on its juices, remaining immobile. After mating, the fertilized female increases in size and gives birth to tiny nymphs. The nymphs secrete a waxy white substance over their bodies for protection from water loss and excessive sun. This substance makes the cochineal insect appear white or grey from the outside, though the body of the insect and its nymphs produces the red pigment, which makes the insides of the insect look dark purple. Once ensconced, they never move from this spot for the rest of their lives, which can last up to three years. The males, on the other hand, live about a week, and exist solely to mate with as many females as they can find. It is literally their only mission in life; they don't even feed, lacking mouth parts to do the job. Adult males can be distinguished from females in that males have wings, and are much smaller in size than females.

Host Cacti

There are 200 species of Opuntia cacti, and while it is possible to cultivate cochineal on almost all of them, cochineal is most commonly found on prickly pear cactus in the western U.S. and Colorado. Feeding cochineals can damage the cacti, sometimes killing their host.

Farming

There are two methods of farming cochineal: traditional and controlled. Cochineals are farmed in the traditional method by planting infected cactus pads or infecting existing cacti with cochineals and harvesting the insects by hand. The controlled method uses small baskets called Zapotec nests placed on host cacti. The baskets contain clean, fertile females that leave the nests and settle on the cactus to await insemination by the males. In both cases the cochineals have to be protected from predators, cold, and rain. The complete cycle lasts 3 months during which the cacti are kept at a constant temperature of 27 °C (81 °F). Once the cochineals have finished the cycle, the new cochineals are ready to begin the cycle again or to be dried for dye production.

To produce dye from cochineals, the insects are collected when they are approximately ninety days old. Harvesting the insects is labor-intensive, as they must be individually knocked, brushed, or picked from the cacti and placed into bags. The insects are gathered by small groups of collectors who sell them to local processors or exporters.

Several natural enemies can reduce the population of the insect on its cacti hosts. Of all the predators, insects seem to be the most important group. Insects and their larvae such as moths, which destroy the cactus, and predators such as lady bugs, lacewings and ants have been identified, as well as numerous parasitic wasps. Many birds, rats and reptiles also prey on cochineal insects. In regions dependent on cochineal production, pest control measures have to be taken seriously.

Farming in Australia

Prickly pear was first taken to Australia in an attempt to start a cochineal dye industry in 1787, when Captain Arthur Phillip collected a number of cochineal-infested plants from Brazil on his way to establish the first European settlement at Botany Bay (part of which is now Sydney, New South Wales). At that time, Spain and Portugal had a worldwide monopoly (via their New World colonial sources) on the cochineal dye industry, and the British desired a source under their own control, as the dye was important to their clothing and garment industries (it was used to color the British soldiers' red coats, for example). The attempt was a failure in two ways: the Brazilian cochineal insects soon died off, but the cactus thrived, eventually overrunning about 100,000 square miles of eastern Australia. The cacti were eventually brought under control in the 1920s by the deliberate introduction of a South American moth, whose larvae fed on the cactus.

Dye

A deep crimson dye is extracted from the female cochineal insects. Cochineal is used to produce scarlet, orange and other red tints. The coloring comes from carminic acid. The insects are killed by immersion in hot water (after which they are dried) or by exposure to sunlight, steam, or the heat of an oven. Each method produces a different color that results in the varied appearance of commercial cochineal. It takes about 70,000 insects to make one pound of cochineal dye. There are two principal forms of cochineal dye: cochineal extract is a coloring made from the raw dried and pulverized bodies of insects, and carmine is a more purified coloring made from the cochineal.

Uses

Traditionally cochineal was used for coloring fabrics. During the colonial period, with the introduction of sheep to Latin America, the use of cochineal increased, as it provided the most intense color and it set more firmly on woolen garments than on clothes made of materials of pre-Hispanic origin such as cotton, agave fibers and yucca fibers. Once the European market had discovered the qualities of this product, their demand for it increased dramatically, and by the start of the seventeenth century it was traded internationally. Carmine became strong competition for other colorants and was used for dyeing the clothes of kings, nobles and the clergy. For the past several centuries it was the most important insect dye used in the production of hand-woven oriental rugs. It was also used for painting, handicrafts, and tapestries. Cochineal-colored wool and cotton are still important materials for Mexican folk art and crafts.

Today, it is used as a fabric and cosmetics dye and as a natural food coloring, as well as for oil paints, pigments and watercolors. When used as a food additive the dye must be included on packaging labels. U.S. Food and Drug Administration regulations require all foods and cosmetics containing cochineal to declare it on their ingredient labels.

Cochineal is one of the few water-soluble colorants that resist degradation with time. It is one of the most light- and heat-stable and oxidation-resistant of all the natural colorants and is even more stable than many synthetic food colors. The water-soluble form is used in alcoholic drinks; the insoluble form is used in a wide variety of products. Carmine can be found in marinades, alcoholic drinks, bakery products and toppings, cookies, desserts, icings, pie fillings, jams, preserves, gelatin desserts, juice beverages, varieties of cheddar cheese and other dairy products, sauces, and sweets. The average human consumes one to two drops of carminic acid each year with food.

Carmine is one of the very few pigments considered safe enough for use in eye cosmetics. A significant proportion of the insoluble carmine pigment produced is used in the cosmetics industry for hair- and skin-care products, lipsticks, face powders, rouges, and blushes.