



## WonderQuest

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### Royal jelly a queenly food, shipyards the world over, smallest bird (and egg)

**Q: How does royal jelly create a queen honeybee? Are other bees affected by feeding the jelly to the queen? And what happens if the feeding regimen is interrupted or stopped?** (Washington, DC)



A queen bee with her retinue.

A: The nature of honeybees turns the question on its head. All female larvae are destined to be queens. Nurse bees interfere with the destiny of most by limiting the royal-jelly diet — thereby turning them into female workers instead. The lack of royal jelly creates sterile workers. Queens become queens because the royal jelly stimulates the correct hormone production to fully develop egg-producing organs.

Recent research in Brazil has peered into when and how these organs develop for queens or don't develop for workers. This is what R.D. Reinato and her advisor, biology professor C. Cruz-Landim, at the São Paulo State University have discovered.

All female larvae start off with the same reproductive equipment (and are otherwise genetically the same, too). The pertinent parts are the egg-producing ovarioles — long skinny subdivisions of the ovaries. To start with, larval workers and queens have the same number of ovarioles.

For the first 2.5 to 3 days, the situation persists. Worker and queen larvae mature in different cells but that makes little difference in their development. The important thing is — both get 100% royal jelly. So, they stay the same.

On about day 2.5, nurses quit giving larval workers 100% royal-jelly food and give them a mixture of jelly, pollen, and honey instead. The workers get *much* less jelly than the queens. Nurses continue to give larval queens only royal jelly. Over the next 2.5 days, the number of worker ovarioles dwindles.

On day 5, workers and queens differ vastly in ovarioles count. Then, both worker and queen larvae spin cocoons and pupate (undergo several changes to emerge as adult bees).

Workers continue to reabsorb their ovarioles into their bodies through pupation. As emerging adults, workers have only about 10, whereas queens have over 100. With so few egg-producing ovarioles left, the larval workers largely lose the ability to reproduce.

In about 7 days, "the queen leaves the colony alone and flies to places called drone congregation areas where she meets and mates with about a dozen drones, probably most from different colonies," says Scott Camazine, co-author of *Self-Organization in Biological Systems* and a biologist. She then starts a new colony.

Royal jelly is a milky-white cream, strongly acid, rich in protein, sugars, vitamins, RNA, DNA, and fatty acids.

How the jelly creates queens is connected with the production of an insect hormone. "Apparently royal jelly does its work through its effect on juvenile hormone," says Camazine. This amazing hormone can, for example, keep caterpillars in the larval stage and prevent them from developing into adults. It puts them into an 'eternal youth' state and keeps them there.

It's likely that lots of royal jelly changes juvenile hormone levels in maturing larvae so females fully develop their egg-producing organs, says Camazine. The jelly seems to influence hormone level so that workers (who don't get enough of jelly) fall into an 'eternal youth' state but queens (who get plenty) don't and therefore mature.

No other bees are immediately affected by feeding jelly to the queen larvae. The nurses are jelly-producers and feeders as a normal part of all worker bee development. These nurse bees are young workers, about 3 to 10 days old. They make royal jelly in glands near their mouthparts.

What happens if the royal-jelly feeding is interrupted or stopped? "This never happens in nature," says Camazine. We tinker with such phenomena in the laboratory to better understand what's going on. We know that feeding more jelly to worker larvae results in a bee that's something in between (intercaste) — neither queen nor worker. Probably the same thing happens if we were to stop feeding jelly to a queen.

By the way, ancient Egyptians kept honeybees over 5,500 years ago.

#### **Further reading:**

• [Brazilian journal of biology: Ovarian growth during larval development of queen and worker of \*Apis mellifera\* by Rejane Daniele Reginato](#)

• [Images by Scott Camazine: Honeybee behaviors](#)

• [North Carolina State University: Female insect reproductive system by John R. Meyer \(with animated illustrations\)](#)

• [North Carolina State University: The dance language of the honeybee](#)