

# THE MYSTERIES OF MOONMILK

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## What is moonmilk?

Moonmilk is a soft white deposit found in caves all over the world that can occur in a number of forms. It can be a paste-like white mud, smooth or lumpy and wet, or dry and powdery.

Moonmilk deposits are predominately made of calcium carbonate. It has been known for over 60 years that moonmilk contains microorganisms, but research is still ongoing as to what the exact role of these is in the formation of moonmilk.

The term 'moonmilk' is thought to have been coined by Gessner in 1555 (Duckeck, 2021) who described moonmilk as a remedy for acidosis and heartburn.



## Microbes in moonmilk

In 1959 Mason-Williams was one of the first to identify microbes in moonmilk. This began a period of interest in the formation of moonmilk and its properties. In 1973 Boquet et al showed that bacteria from soil are capable of precipitating calcium carbonate from a calcium source. In fact this appears to be a relatively common feature of bacteria.

Cave bacteria have access to dissolved calcium as well as nutrients in the cave drip waters that they live near. Cave bacteria have therefore evolved an enhanced capability for calcium carbonate production.

### **How is moonmilk formed?**

We know from previous studies that moonmilk contains bacteria, and that many bacteria are capable of precipitating calcium carbonate. The exact nature of this relationship is uncertain, however recent studies have provided some insights into how this process might work.

There are 3 main theories on how moonmilk is formed:

- 1.The microbes act as nucleation sites for calcium carbonate precipitation.
- 2.The microbes actively precipitate calcium carbonate.
- 3.Calcium carbonate precipitation is independent and the presence of microbes is incidental.

Banks et al (2010) showed that in order for calcium carbonate precipitation to occur the bacterial cells need to be active. In their experiment precipitation did not occur when inactive cell cultures were used. This suggests that bacteria themselves are responsible for moonmilk formation.

Bacteria may achieve this by increasing the pH of their surroundings to above pH8, facilitating calcium carbonate precipitation. Calcium ions are toxic to bacteria, so it is thought they have evolved this ability as a means to remove calcium and live in such an unfavourable environment.

### **Uses of bacteria from caves**

A number of recent studies have been examining the potential for bacterial strains isolated from moonmilk to be used in the development of new antibiotics. Bacteria from may also prove useful in bio-building materials and, bioremediation of contaminated land and other applications.

#### **References**

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**Mason-Williams, A.** (1959). "The formation and deposition of moonmilk." *Trans. Cave Res. Group* 5(2): 133-138.



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