Got milk? Roach milk could be a new superfood

Scientists find nutritious 'milk' inside one type of cockroach

DINSA SACHAN

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This is the molted shell of the Pacific beetle cockroach, left behind on a Hawaiian leaf. Mother’s 'milk' from this insect is three times more nutritious than cow’s milk, new data show.

Many people don’t consider their breakfast complete without a glass of milk. Right now, cows, buffaloes, goats and sheep provide most of the world’s milk. But soon, people could be sipping milk from cockroaches. At least, that’s what an international group of scientists is proposing.

That’s not as crazy as it might sound. New research shows this "milk" is super-nutritious. What’s more, some scientists have already begun referring to many insects as mini-livestock.

In 2004, Subramanian Ramaswamy started studying crystals that are found inside the guts of cockroach embryos. At the time, he was teaching biochemistry at the University of Iowa in Iowa City. (Now Ramaswamy studies a host of topics — including infectious diseases — at the Institute for Stem Cell Science and Regenerative Medicine. It’s in Bangalore, India.)

The crystals had come from the Pacific beetle cockroach. This is the only cockroach species that’s viviparous (Vy-VIP-er-us). That means it gives birth to live young. The cockroach mothers feed the babies growing inside them with a milk-like liquid. That milk contains the crystals, which are made of protein.

To learn more about these milk crystals, the scientists needed to study them up close. “To see an object, you will throw light on it,” Ramaswamy says. “To look at atoms or molecules, you’d want to use wavelengths of [light] that are smaller than the distances between atoms and molecules.” X-rays are a form of light, he explains. And their wavelengths are the right size to see atoms in a crystal of some protein.

The atoms in the crystal will cause any x-rays beamed at it to scatter somewhat. That’s why this scanning technique is known as x-ray diffraction. And the scatter pattern that emerges helps scientists map the placement of those atoms making up the crystal’s structure.

The scanning data basically revealed the chemical recipe of the cockroach crystal. They showed that cockroach milk is a “complete food.” It contains sugar with a fatty acid stuck to it. (Fatty acids are the building blocks of fats). The protein in the milk is also chock full of essential amino acids. Amino acids are the building blocks of proteins. Since our bodies can’t manufacture the “essential” ones, we need to get them from our food. And so do baby cockroaches.

Barbara Stay also worked on the new study. She’s a biologist at the University of Iowa. She says the new data show that the roach milk is “three times more nutritious than cow’s milk and four times more nutritious than buffalo’s milk.” That would make it a very rich source of body-building ingredients.

The team’s findings appear in the July issue of IUCrJ. It’s a journal put out by the International Union of Crystallography.

Ramaswamy would like to see cockroach milk turned into a protein supplement to feed hungry people. But not everyone is confident it can be done.

Marcel Dicke studies insects as a potential source of human food at the Wageningen University in the Netherlands. Dicke says this is a “sound study.” But he believes it would be difficult to extract milk from cockroaches on a large scale, like we do with cattle. In his opinion, “it can only likely be done in a destructive way with only minute quantities.” That means you would have to raise — and kill — a lot of bugs to get even tiny quantities of the milk.

Another possibility would be to make this milk on a large scale in vats using yeast. Biotechnologists use yeast to make a number of products, including medicines. They do this by adding new genes to yeast microbes. In this case, they would add the genes that the cockroach uses to make its milk protein.

Yet for now, even Ramaswamy admits that industrial production of this milk “is wishful thinking.” That is, if what you’re wishing for is a cold glass of cockroach milk.

Power Words

amino acids Simple molecules that occur naturally in plant and animal tissues and that are the basic constituents of proteins.

atom The basic unit of a chemical element. Atoms are made up of a dense nucleus that contains positively charged protons and neutrally charged neutrons. The nucleus is orbited by a cloud of negatively charged electrons.

biotech Short for biotechnology, which is the use of living cells to make useful things. People who work in this field are known as biotechnologists.

crystal (v. crystallize) A solid consisting of a symmetrical, ordered, three-dimensional arrangement of atoms or molecules. It’s the organized structure taken by most minerals. Apatite, for example, forms six-sided crystals. The mineral crystals that make up rock are usually too small to be seen with the unaided eye.

crystallography A field of science that studies crystals, especially their structure and composition.

embryo The early stages of a developing vertebrate, or animal with a backbone, consisting only one or a or a few cells. As an adjective, the term would be embryonic — and could be used to refer to the early stages or life of a system or technology.

essential amino acids A type of important nutrient, used to build proteins, that cannot be made by the body. It must be acquired from an animal’s foods.

fatty acid A large molecule made of up chains of carbon and hydrogen atoms linked together. Fatty acids are chemical building blocks of fats in foods and the body.

insect A type of arthropod that as an adult will have six segmented legs and three body parts: a head, thorax and abdomen. There are hundreds of thousands of insects, which include bees, beetles, flies and moths.

molecule An electrically neutral group of atoms that represents the smallest possible amount of a chemical compound. Molecules can be made of single types of atoms or of different types. For example, the oxygen in the air is made of two oxygen atoms (O2), but water is made of two hydrogen atoms and one oxygen atom (H2O).

mini livestock A term for some scientists use for insects that would be used for human food. These small animals would be reared — farmed — to create protein-rich dietary ingredients.

protein Compound made from one or more long chains of amino acids. Proteins are an essential part of all living organisms. They form the basis of living cells, muscle and tissues; they also do the work inside of cells. The hemoglobin in blood and the antibodies that attempt to fight infections are among the better-known, stand-alone proteins. Medicines frequently work by latching onto proteins.

supplement (in nutrition) Something taken in pill or liquid form — often a vitamin or mineral — to improve the diet. For instance, it may provide more of some nutrient that is believed to benefit health.

viviparous Animal species that give birth to live young and nourish them while they’re developing, prior to birth.

wavelength The distance between one peak and the next in a series of waves, or the distance between one trough and the next. Visible light — which, like all electromagnetic radiation, travels in waves — includes wavelengths between about 380 nanometers (violet) and about 740 nanometers (red). Radiation with wavelengths shorter than visible light includes gamma rays, X-rays and ultraviolet light. Longer-wavelength radiation includes infrared light, microwaves and radio waves.

x-ray diffraction It is a technique that is used to study the structure of crystalline substances. X-ray radiation is used to study the distribution of atoms inside the crystal.

x-ray A type of radiation analogous to gamma rays, but of somewhat lower energy.

yeast One-celled fungi that can ferment carbohydrates (like sugars), producing carbon dioxide and alcohol. They also play a pivotal role in making many baked products rise.

Readability Score:

7.2

Citation

JOURNAL: S. Banerjee et al. Structure of a heterogeneous, glycosylated, lipid-bound, in vivo-grown protein crystal at atomic resolution from the viviparous cockroach Diploptera punctate. IUCrJ. Published July 2016. doi: 0.1107/S2052252516008903

**Questions –**

1. **Define molecule:**
2. **Explain how the crystals found in the Pacific Beetle Cockroach is related to changes in states of matter.**
3. **Explain how an x-ray works.**
4. **How do fatty acids relate to molecules/compounds?**
5. **How would using yeast to create the roach milk relate to chemical changes we studied in science class?**
6. **Choose 4 of the power words located at the end of this article. Explain how the four words you chose relate to physical science.**