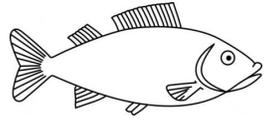


How Do Goldfish Survive Winter? They Make Alcohol!

By **Jason Daley** | SMITHSONIAN.COM | AUGUST 14, 2017 (*adapted by S. Muskopf*)



Animals produce plenty of weird compounds. Take, for example, squid ink, skunk spray or even hagfish slime. But one of the strangest animal-produced byproducts is goldfish **alcohol**. When our finned friends are in low oxygen environments, like at the bottom of a frozen pond, goldfish and related carp species produce alcohol from their gills. Now, researchers have finally figured out how the critters produce this fishy moonshine.

For most vertebrate animals, when oxygen is no longer available, the body switches to anaerobic respiration, which it quickly breaks down carbohydrates for energy. But similar to how sprinters can only maintain their zip for short distances, fish can only rely on this process for a short time due to the buildup of lactic acid, which is dangerous in high concentrations.

Goldfish, however, metabolize those carbs differently than other animals when oxygen is scarce. The creatures convert these carbs to ethanol, which they expel from their gills. This means the lactic acid does not build up in their bodies, allowing them to survive in the low oxygen environment.

To study the fish, a team of researchers put crucian carp in a “goldfish hotel,” where they studied them for seven days. The researchers found that the muscle tissue of the fish contains enzymes that bring carbohydrates to mitochondria, the cellular powerhouses where energy is produced. In a low-oxygen environment, an enzyme called pyruvate decarboxylase turns on, processing the metabolic waste to produce the less-dangerous ethanol.

During the extended periods of ice cover in northern Europe, blood alcohol concentrations in crucian carp can reach more than 50 mg per 100 milliliters, which is above the drunk driving limit in these countries. This is still a much better situation than filling up with lactic acid, which is even more toxic than alcohol. Researchers also sequenced the animal’s DNA, finding that the booze-brewing mutation evolved in the ancestor of carp and goldfish about 8 million years ago. It’s a pretty impressive survival adaptation. The ethanol production allows the crucian carp to be the only fish species surviving and exploiting these harsh environments.

1. Determine the central theme of the passage. What **CLAIM** is being made about goldfish?

2. How does the cold water of a pond in winter differ from the summer environment?

3. What happens during anaerobic respiration?

4. How did scientists discover that crucian carp have a unique ability? This is **EVIDENCE**

5. Suggest a **REASON** why would crucian carp have developed this ability