

The unique pentraxin-carbonic anhydrase protein regulates the ability of fish to swim

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A study carried out at the University of Tampere has shown that carbonic anhydrase VI (CA VI) is present in some species as a combination of two proteins. According to current data, this "fusion protein," called pentraxin-carbonic anhydrase, has disappeared from the genome of almost all mammals through evolution.

Carbonic anhydrases (CAs) are enzymes that catalyse the transformation of water and [carbon dioxide](#) into bicarbonate and [hydrogen ions](#). They play an important role in maintaining the acid-base balance of many tissues and biological fluids.

CAs are present in almost all organisms. Humans express 15 CA isoforms. Professor Seppo Parkkila's research group at the University of Tampere's Faculty of Medicine and Life Sciences investigated isoenzyme VI, the CA VI enzyme that humans secrete into saliva and milk. It is the only known secreted CA. "We have conducted this study for over 10 years," Professor Parkkila says.

Pentraxin is a close relative of C-reactive protein (CRP), which is mainly produced by the liver. Its levels quickly increase in the human body in inflammatory conditions, and the CRP concentration of the plasma is the most commonly used inflammatory indicator in clinical medicine.

The research group's study used zebrafish embryos. For a five-day period, the gene that produces CA VI was silenced in the fish. The change had a clear effect on their ability to swim.

"The fish whose organs did not produce the 'fusion protein' prospered and were healthy in other respects, except that they were unable to stay close to the water's surface; instead, they sank to the bottom of the pool. The swim bladder of the fish did not function normally. When the gene function resumed at about five days of age, the development of the zebrafish returned to normal," Parkkila explains.

In humans, carbonic anhydrases and pentraxins are not related to each other, but are completely separate proteins. The "fusion [protein](#)" is present in frogs, birds and fish. The same feature is also found in one of Australia's most iconic animals.

"The platypus, which is an egg-laying mammal, is probably the most advanced animal in which this combination of proteins is found," Parkkila says. The gene encoding pentraxin-[carbonic anhydrase](#) has not been found in mammals that give birth to live offspring.

In addition to the researchers at the University of Tampere, researchers from Italy, Nepal, Hungary and elsewhere in Finland participated in the study. The research results have been published in the *PeerJ* open access journal.

More information: Maarit S. Patrikainen et al, Identification and characterization of a novel zebrafish (*Danio rerio*) pentraxin–carbonic anhydrase, *PeerJ* (2017). [DOI: 10.7717/peerj.4128](https://doi.org/10.7717/peerj.4128)

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