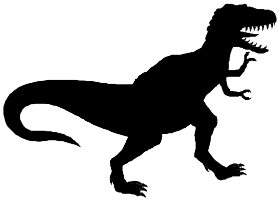

ScienceWatch – But Does it Taste Like Chicken?

Some dinosaur protein has survived for 68 million years

Two years ago I described the discovery of a *Tyrannosaurus rex* skeleton that had not completely fossilized - *see - ScienceWatch – T. rex in the Flesh?* (May 2005), or www.hras.org. When an animal dies soft tissue rapidly decays, while the longer-lasting bone may under certain conditions become fossilized by turning to stone. However, the paleontologists who found this skeleton were in for a surprise. After cutting into the leg bones and dissolving the surrounding mineral deposits with weak acid, a rubbery material resembling bone marrow was revealed. The acid treatment had exposed a soft tissue that was flexible and resilient, and under the microscope appeared to be composed of blood cells and blood vessels. Remarkably, this specimen was preserved under special conditions that prevented some of the soft tissue deep inside the leg bones from decaying or being fossilized so that some dinosaur protein survived for 68 million years.

Now two teams, reporting in the April 13, 2007 issue of *Science* describe their work on the recovery and characterization of protein fragments isolated from the *T. rex* bone marrow. Their results show that the protein fragments most resemble a chicken protein, collagen I, and provide further evidence for the link between dinosaurs and birds.

All proteins are composed of a chain of subunits called amino acids and there are 20 different amino acids, any one of which may occur at any position in the chain. One of the teams, headed by Mary Higby Schweitzer, of North Carolina State University, who first discovered the bone marrow two years ago, analyzed protein extracts of the bone marrow for their amino acid content. The amounts of various amino acids found in the extracts closely resembled that which is known for collagen I, the main organic component of bone. Next the team showed that antibodies, which strongly reacted specifically with collagen I from chickens (*Gallus gallus*), also showed a high degree of reactivity to the protein in the marrow extract. Furthermore, the reactivity disappeared if they first exposed the extract to an enzyme that digests collagen. These results show that the collagen I present in the extract is closely related to that from chickens.

The second team, lead by John Asara of Harvard Medical School and Beth Israel Deaconess in Boston, used an independent method to come to the same conclusions. They subjected the extracts to mass spectrometry (MS), a very sensitive technique that can determine the mass and chemical makeup of minute amounts of a substance present in a sample. The team isolated several protein fragments from the *T. rex* soft tissue extract. Using MS they determined the amino acid sequences in each fragment, and with the help of a database of known sequences of collagen I from a variety of organisms, they also found that the *T. rex* protein fragments most closely resembles chicken collagen I. Collagen I from a frog (*Xenopus laevis*) came in a close second.

Until now the oldest proteins have come from 100,000-300,000 year-old mammoth remains and ancient DNA has been extracted from the tissue of Neanderthals that lived about 50,000 years ago. Dinosaur genetic studies and cloning-a la Jurassic Park-require the extraction of DNA. However, sequencing of dinosaur DNA is problematic because the DNA in fossils that old is highly degraded, leaving only short DNA sequences - not enough to learn much. On the other hand, proteins are much more prevalent in tissues, are hardier than DNA, and as we have seen from these two reports, can survive long enough under certain conditions to provide information on the evolutionary relatedness of dinosaurs to living organisms that cannot be found by looking at bones alone.

Schweitzer believes that the proteins found in this *T. rex* fossil were well preserved for three reasons. First, the dinosaur was buried deeply in sand soon after death, eliminating most of the oxygen that would promote decay. Second, the digestive enzymes released as the soft tissue broke down could rapidly drain away in the porous sand and not destroy all the proteins. Finally, the proteins in the marrow became bound to iron released from hemoglobin, protecting them from further degradation. You can bet that paleontologists are avidly searching for other fossils buried in a similar manner.

Meanwhile, what do think a *T. rex* drumstick might taste like?

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