Researchers discover eye test for neurological diseases in livestock

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(PhysOrg.com) -- The eyes of sheep infected with scrapie - a neurological disorder similar to mad cow disease - return an intense, almost-white glow when they're hit with blue excitation light, according to a research project led by Iowa State University's Jacob Petrich.

The findings suggest technologies and techniques can be developed to quickly and noninvasively test for transmissible spongiform encephalopathies, progressive and fatal neurological diseases such as mad cow disease in cattle and Creutzfeldt-Jakob disease in humans. Petrich, in fact, is working to develop a testing device.

The findings were published earlier this year in the journal *Analytical Chemistry*. The project was supported by a grant from the U.S. Department of Defense.

The research is the result of an accidental discovery while Petrich and his collaborators were developing a fluorescence spectroscopy device that's now used in slaughterhouses to test livestock carcasses for feces and possible E. coli contamination.

"One day we were testing the apparatus by shining light on the carcass and we saw the spinal cord glow - it fluoresced," said Petrich, professor and chair of Iowa State's chemistry department. "We saw the spinal cord through the skin. The light was pretty intense. It was an amazing result."

That sparked some new thinking: Maybe fluorescence technology could

be used to test animals for transmissible spongiform encephalopathies such as bovine spongiform encephalopathy - what's often called mad cow disease. To reduce the risk of human exposure to the diseases, the brains and spinal cords of animals are removed during slaughter and processing. But there is no quick test to identify animals with the diseases.

And so Petrich and a team of researchers began studying the feasibility of a fluorescence test. The team included Ramkrishna Adhikary, an Iowa State graduate student in chemistry; Prasun Mukherjee, a former Iowa State graduate student and current post-doctoral associate in chemistry at the University of Pittsburgh; Govindarajan Krishnamoorthy, a former Iowa State post-doctoral research associate and current assistant professor of chemistry at the Indian Institute of Technology Guwahati; Robert Kunkle of the U.S. Department of Agriculture's National Animal Disease Center in Ames; Thomas Casey of the National Animal Disease Center; and Mark Rasmussen of the U.S. Food and Drug Administration's Center for Veterinary Medicine in Laurel, Md.

The researchers collected 140 eyeballs from 73 sheep. Thirty five of those sheep were infected with scrapie; 38 were not. The researchers took fluorescence readings from various parts of the eyes of all the sheep.

"The bottom line is the scrapie-positive retinas fluoresced like crazy," Petrich said. "And the scrapie-negative ones did not."

A previous study published in the journal Veterinary Pathology reported that the function and structure of retinas are altered in cattle infected with transmissible mink encephalopathy. Members of that study team included Iowa State researchers M. Heather West Greenlee, an associate professor of biomedical sciences in the College of Veterinary Medicine; Justin Greenlee, a collaborator assistant professor of biomedical

sciences; and Juergen Richt, a collaborator associate professor of veterinary microbiology and preventive medicine.

Other studies have reported that lipofuscin, an intracellular fluorescent pigment, accumulates in the eyes of animals infected with the neurological diseases. Petrich and his team attribute the glow from scrapie-positive retinas to the elevated levels of lipofuscin.

Whatever the cause, Petrich said it's clear there are distinct differences in the fluorescence and spectroscopic signatures of retinas from sheep that were naturally infected with scrapie and those that were not. And so he and his research team think there's great promise for a diagnostic test based on that discovery.

That has Petrich starting to develop a device (he likes to call it a "gizmo") that could be used in meat plants to test the retinas of animals for signs of neurological diseases. He expects it will take several years to develop, build and test a useful device.

"What I like about this is it's really simple," Petrich said. "It's light in and light out."

More information: pubs.acs.org/doi/pdfplus/10.1021/ac100179u

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