Red hair is a sign of oxidative stress in wild boars, but gray is a-ok

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A coat of a certain color could be costly for wild boars, according to research published in the journal *Physiological and Biochemical Zoology*.

The research, led by Ismael Galván of Spain's Museo Nacional de Ciencias Naturales, found that boars with more reddish hair tend to have higher levels of oxidative stress—damage that occurs as toxins from cell respiration build up. The reason for this, the researchers suggest, is that the process of producing reddish pigment eats up a valuable antioxidant that would otherwise be fighting the free radicals that lead to oxidative stress.

Most of the pigment in animal skin and hair is produced by chemicals called melanins. There are two kinds of melanins: eumelanin, which produces dark colors, and pheomelanin, which produces reddish or chestnut colors. The two melanins are produced via similar chemical pathways, with an exception. The production of pheomelanin consumes a chemical called glutathione (also known as GSH), which is a powerful intracellular antioxidant.

To see if this consumption of GSH has physiological consequences, Galván and his team studied a population of wild boars in Doñana National Park in southwestern Spain. The researchers quantified the amount of reddish fur each boar had, and tested levels of GSH and oxidative stress in the muscles of each animal.

They found that the boars with the highest levels of pheomelanin in their

hair tended to have lower levels of GSH in their muscles, and had the highest levels of oxidative stress. "This suggests that certain colorations may have important consequences for wild boars," Galván said. "Pheomelanin responsible for chestnut colorations may make animals more susceptible to oxidative damage."

The results corroborate findings in other studies on birds and other animals suggesting the production of pheomelanin imposes physiological constraints. In humans, red hair and high pheomelanin in skin has been linked to higher rates of cancer. These findings raise a question: Why did pheomelanin evolve in the first place?

Galván suggests one possible answer. While consuming GSH, pheomelanin production also consumes a chemical called cysteine, which is part of GSH and can be toxic in excess. "Pheomelanin may have evolved because cysteine, which is toxic at very high levels, is removed from cells during pheomelanin production," Galván said.

Surprising Results for Grays

While the findings for red hair echoed results of other studies, there were some surprising results for gray hair in wild boars. Studies in humans have suggested that graying hair—the absence of melanin—may happen as a result of oxidative stress. "As with human hair, wild boars show hair graying all across their body fur," Galván said. "But we found that boars showing hair graying were actually those in prime condition and with the lowest levels of oxidative damage. Far from being a sign of age-related decline, hair graying seems to indicate good condition in wild boars."

Research into the consequences of different levels of melanin is only just beginning, Galván says, and he hopes this research will spur continued study.

"Given that all higher vertebrates, including humans, share the same types of melanins in skin, hair, and plumage, these results increase our scant current knowledge on the physiological consequences of pigmentation," he said.

More information: Ismael Galván, Carlos Alonso-Alvarez, and Juan J. Negro, "Relationships between Hair Melanization, Glutathione Levels, and Senescence in Wild Boars." *Physiological and Biochemical Zoology* 85:4 (July/August 2012).

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