Cupriavidus metallidurans: A Modern Alchemist

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Recent discovery on the potential use of a bacterium has revealed that it can yield 24-carat gold in one week. Scientists from Michigan State University, USA, Kazem Kashefi, assistant professor of microbiology and Adam Brown, associate professor of electronic art and intermedia, found that a bacterium, *Cupriavidus metallidurans* (previously known as *Ralstonia metallidurans*) [1] that belongs to beta class of proteobacteria can grow on a substantial concentration of toxic gold chloride (also known as liquid gold). Further reports from Australia have confirmed this microbial process involved in cycling of gold, based on the 99 % similarity of 16S rDNA obtained from template (gold grains) to *R. metallidurans* [2]. The bacterium with such potential was first isolated in 1976 from the sludge of a metal processing factory located in Belgium [3]. Its ability to detoxify gold complexes by transforming them into metallic gold was discovered in 2009 [4]. When discovered, the bacterium was initially found to be resistant to cadmium but subsequent studies identified that this strain is multi-metal resistant and has two plasmids pMOL28 and pMOL30 which harbor multiple loci for metal resistance [5]. The plasmid pMOL28 contains genes involved in resistance to Co(II), Cr(VI), Hg(II) and Ni(II) which are present on a 34 Kb region, whereas a 132 Kb region on the plasmid pMOL30 contains the genes involved in resistance to the metals Ag(I), Cd(II), Co(II), Cu(II), Hg(II), Pb(II), and Zn(II) [5, 6]. The bacterium's ability to thrive in toxic environments with a high number of heavy metal resistant genes makes it an excellent model organism to study the means by which microbes deal with heavy metal stress.

Such unique ability of this extremophile to metabolize toxic substances might also provide an insight into understanding the origin of life.

This microbial magician, *C. metallidurans*, when placed in a minilab full of gold chloride converts it to 24-carat gold in a week's time, a process that this bacterium is thought to carry out regularly in nature. This finding by Kazem Kashefi and Adam Brown has been exhibited as an art installment called "The Great Work of the Metal Lover". The art work consists of a portable lab which consists of a glass bioreactor containing the bacteria. While Kashefi calls this as microbial alchemy, Brown calls it as neo-alchemy which is a cross between modern microbiology and alchemy. This artwork received an honorable, mentioned in the world renowned cyber art competition, Prix Ars Electronica 2012, held in Austria [7].

Producing pure gold from bacterium seems to be a boon at a time when the price of gold has reached an all time high. But, does this mean that the scientists have got the answer to the international debt crises? Although this bacterium can produce the 24-carat pure gold, but it has been said that it will be cost prohibitive to carry out this experiment at a larger scale. So, one should not see this as a golden investment in economic crisis. But, this discovery has surely created a debate over the use of science and technology, the greed and other economic and environmental impacts associated with it. This work can be used to address questions regarding the ethics related to science and the magnificent engineering of nature.

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