

On the other hand, the centric diatom retained more features found in other eukaryotes such as the flagellar apparatus, which may be functional in planktonic life. The detection of a similar number of diatom-specific gene families and eukaryotic gene families not found in diatoms, reveals that the rates of gene gain and gene loss are similar and consistent with the high diversification rates observed in diatoms. It is also confirmed that diatom-specific genes are evolving faster than other genes in diatom genomes, providing a further explanation for the rapid diatom divergence rates. Moreover the presence of 10 and 42 diatom-specific cyclin genes in *P. tricornutum* and *T. pseudonana* respectively reflects the unusual characteristics of diatom life cycles due to the rigid silica cell walls, such as the control of cell-size reduction, activation of sexual reproduction at a critical size threshold, and life in rapidly changing and unpredictable environments.

This study suggests that genes acquired after secondary endosymbiosis by gene transfer from bacteria are pervasive in diatoms and represent at least 5% of their gene repertoires. Findings show that gene transfer between diatoms and other organisms has been extremely common, making diatoms 'transgenic by nature'.

The study also proposes that gene transfer from bacteria to diatoms, and perhaps vice versa, has been a common event in marine environments and has been a major driving force during diatom evolution. It has also brought together highly unorthodox combinations of genes permitting non-canonical management of carbon and nitrogen in primary metabolism and the sensing of external stimuli adapted to aquatic environments. The combination of mechanisms reported here may underlie the rapid diversification rates observed in diatoms and may explain why they have come to dominate contemporary marine ecosystems in a relatively short period of time.

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Perilous outcomes of arsenic

Neelam Pereira

The benign staple of rice may be a carrier of cancer risk, if latest research is to be believed. The wonder grain that feeds a large chunk of the Asian populace is said to contain ten-fold higher arsenic concentrations than wheat and other cereals¹. It is speculated that rice sourced from arsenic-polluted groundwater exceeds an upper limit of 50 µg arsenic and may stretch to 400 µg per kg. Contaminated wells contain arsenic levels that are manifold compared to the permissible limits of 10 µg per litre set by the World Health Organization (WHO).

Arsenic is present in high concentrations in well water in many parts of the western United States, South America

and Taiwan. Industrial use of arsenic along with its extensive use in plant sprays leading to its assimilation into feed of livestock and poultry are the reasons for the environmental dispersion of this compound. Environmental arsenic is also known to occur in some species of fish and shellfish. Inhalation of arsenic-polluted air, smoke as well as ingestion of contaminated food, air and water are also said to cause arsenic-related ailments². The average daily human intake of arsenic³ through food and water is pegged at 300 µg.

History of skin afflictions due to arsenic dates back to 1556. Investigations later have shown that ingestion of inorganic

arsenic can cause skin cancer and inhalation of inorganic arsenic can cause lung cancer. Though both inorganic and organic arsenic occur in varying amounts in food, the inorganic counterpart is considered more dangerous than its organic form⁴.

Recently, scientists have undone the contradiction of the carcinogenic poison being used as a treatment for acute promyelocytic leukaemia. Arsenic, by virtue of its glue-like property, attaches itself to SUMO – a type of molecule involved in leukaemia, which is later attacked by an enzyme called RNF4, in a process known to destroy the cancer-causing proteins. A treatment for blood cancer was success-

fully conducted by researchers at Netaji Subhas Chandra Bose Cancer Research Institute, Kolkata using arsenic trioxide^{5,6}. The medicinal use of arsenic dates back to more than 2400 years³.

The menacing effects of arsenic-contaminated water intake are well known through past records of India and Bangladesh showing high incidences of arsenicosis and skin cancer.

Recent findings in the UK exhibited high levels of inorganic arsenic content in rice bran. This seems to be a cause for concern, as there is no set standard for controlling the amount of arsenic in food. China is one of the few countries to have regulated arsenic levels in food. Though the US FDA recommended a daily intake of 130 µg of inorganic arsenic, it is yet to set legal limits on inorganic arsenic in food. Nutraceuticals, a rice cereal maker in the US concedes that though no health problems have been encountered so far, the country is yet to legalize the amount of arsenic intake¹.

Efforts are ongoing in terms of minimizing the arsenic content in rice. Zhu

Yong-Guan, an environmental biologist at Research Centre for Environmental Studies, Beijing, suggests paddy rice cultivation in raised beds to minimize arsenic absorption risk. Barry Rosen, a molecular biologist from the Wayne State University, Michigan and Zhu are trying to create a species of transgenic rice equipped with a bacterial enzyme that will volatilize arsenic in rice. Another method proposed by experts in the US to alleviate the arsenic problem in rice is to mix both rice with low arsenic and higher arsenic content before sale.

The crux of the problem lies with groundwater arsenic contamination. In the US and Europe, the problem could be blamed on the contaminant spills, whereas in Asia, the source is naturally occurring sediment. Erosion of sediments in the Himalayas leaches arsenic into groundwater along the low-lying areas. In the Ganges delta the arsenic contamination scenario is complicated by an exponential growth in the pond-based irrigation systems, which are altering the solute concentrations present below the ground⁷.

A recently published study demystifies the localization of arsenic through understanding of the groundwater movement and calls for deploying hydrogeological tools to ascertain the safety of water⁸.

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MEETINGS/SYMPOSIA/SEMINARS

UGC National Seminar on Climate Change and Environmental Challenges

Date: 7–8 March 2009
Place: Annamalainagar

Topics include: Climate change; Carbon sequestration; Bio-remediation; Handling and treatment of waste; Biodiversity loss and conservation; Natural disasters; Environmental management.

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National Seminar on Geology by Future Leaders: Challenges and Opportunities from Concepts to Applications

Date: 12–13 June 2009
Place: Dehradun

Themes include: Conventional scrutiny of geological terrain; Core/applied geology; Energy resources – petroleum geology and non conventional energy resources; Hydrological analysis and challenges; Economic geology; Engineering geology and geotechnical engineering; Aspiration oriented geological education; Social Geology – a need today; Climate change – myth or reality?

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